The Electrical World.

VOL. XXVI. NEW YORK, DECEMBER 7, 1895. No. 23.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

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ISOLATED LIGHTING PLANTS.

The installation of an electric light plant in a large office building is beset with certain difficulties that are not usually encountered in other branches of electric construction, the work being in the hands of a contractor, subject to the supervision of an engineer and to the criticism of the architect and owner. From this plurality of supervisors a result that embodies the ideas of all and is satisfactory to none often follows, but the plant, which we describe elsewhere, in the magnificent new building of the American Tract Society is a notable exception to this conclusion. There are three especial features which are to be commended in this plant—its direct-coupled units, its circuit-breakers and well-designed switchboard, and its iron-armored installation. It is too often the case that in a building otherwise magnificent, a very inferior job of electric work is installed, usually due to the disparity of bids and the difficulty of distinguishing between them. The layman does not realize that, to use a common expression, "there are installations and installations," but he can see a difference of one hundred dollars in a bid. An engineer's value is here apparent. Large electric contracts should always, in order to provide for complete specifications and accurate tests for acceptance, be placed in the hands of a competent engineer. Then installations like the one referred to will become more frequent.

GAS ENGINES FOR ELECTRIC LIGHTING PLANTS.

One of our English contemporaries refers to a new application of the gas engine to electrical purposes, consisting of a sub-station gas-engine plant recently installed at Brussels, Belgium. The plant comprises five direct-connected sets of engine and dynamo of 120 hp each, together with a storage battery of 660 hp-hours capacity. This is an indication of the favor with which the gas engine is regarded in Europe, where its use is extending yearly for electrical generating purposes. At present there are four central stations in Great Britain using gas engines, the most recent being a municipal plant at Belfast, Ireland, while on the Continent, and particularly in Germany, the suitability of this prime motor for electrical generating purposes has long since passed beyond the stage of discussion. This side of the water, on the contrary, the gas engine appears to be viewed with suspicion, and has received but little application to any use. No reason is apparent why this should be so, unless it may be ascribed to the relegation in this country of engineering to a commercial rather than a professional basis, which leads to the neglect of whatever is not upheld by a strong commercial interest, or opposition to whatever may be suspected as likely to introduce complications with respect to established interests. The gas engine is no longer in an experimental stage, either from the engineering or commercial standpoint, and it is little to our credit that this is not more fully recognized here.

LOOP SYSTEMS OF WIRING.

Elsewhere in this issue we print in abstract a paper on the calculation of return-loop circuits of wiring, recently read before the Franklin Institute by Mr. E. R. Keller, presenting a method of arriving at numerical results, which can be extended to other cases than those given. It often happens that a considerable number of lights are to be so distributed as to admit of the adoption of a plan of circuits giving more satisfactory results with respect to variation in drop, or to cost of copper and conduit, than would the usual one, but the calculation of the wiring becomes more involved. As formulas may not be had to fit specific cases, it would sometimes be

necessary to calculate them, and the method given by Mr. Keller will enable this to be done. As shown in the article, a plan of wiring, which at first sight would appear to give the same difference of potential at each lamp, does not do so, and this is true of several other supposed methods of obtaining constant difference of potential. The only simple loop-circuit that will enable this to be done is one in which the area of wire is decreased or increased from lamp to lamp, which is, of course, impracticable. A simple way to examine into such cases comparatively is to lay down the different circuits, with, say, 10 lamps placed the same distance apart, each taking one ampere, and separated from each other by a resistance of unity; then the loss of current in each section is simply represented by the square of the current flowing through it, and the sums of these different losses are directly comparable.

POLYPHASE CURRENTS FROM A SINGLE-ALTERNATING CURRENT.

The article by Prof. Fessenden, in another column, on "The Loss of Energy in Changing a Single-Alternating Current into Polyphase Currents," shows quantitatively the objection to this method of obtaining polyphase currents which was pointed out several years ago by Steinmetz. It is evident that if we take a single alternating current and split it so as to have two currents differing in phase, the sum of the energy of the two currents will not be the same at every instant as the energy of the original current, but greater at some instants and less at others. As a consequence, a means of storage for the difference must be provided, which may be furnished either by inductances or condensers, or by the two combined. In the article referred to, the energy efficiency of this system of storage is considered and the conclusions are not encouraging. Unfortunately, still other factors enter which are no less unfavorable, such as the cost, size and reliability of condensers, the cost of inductances and the variability of phase difference with load. There are, of course, cases where "current-splitting" may be employed with advantage, as, for instance, in starting up synchronous motors. Several systems based on this principle have been suggested, and one—that of Mr. C. E. L. Brown—has had a considerable commercial success in Europe. In this case, however, inductances in the motor itself are utilized through a temporary rearrangement of circuits, and the question of efficiency of storage does not, of course, enter.

HYDRO-ELECTROTHERMIC HEATING.

In another column we print an article on what has been called the "water-pail" system of electric heating, in which the principles of this interesting application of the electric current are clearly explained and the scope of its application sketched in detail. Of all the manifestations of electricity this is one of the most curious, for scarcely anything more anomalous can be imagined than the production of the most intense heat known by the mere act, apparently, of plunging the material to be heated into a liquid. Shortly after the discovery of Messrs. Hoho and Lagrange was first announced in this country by The Electrical World, in June, 1893, Mr. Jules Neher, in an article in our columns, held that the heating effect is due to arcs across the gas envelope and not directly to resistance, as was then asserted, and is apparently yet considered to be the case by Mr. Hoho. This point would seem to furnish a desirable subject for investigation by one of our college laboratories, as well as the question of the efficiency of the system. Mr. Neher, in the article referred to, calculates an approximate efficiency in heating iron. It was found that in 15 seconds the temperature of 15 grammes of iron were raised 2000 degrees, and 1500 grammes of water, three degrees, centigrade, 3000 watts of energy being expended; 1048 watts were used in heating the iron, 1257 watts in heating the water, and 30 watts in electrolysis, leaving 665 watts for conduction, radiation and errors, and giving a useful efficiency of but 35 per cent. This calculation was given as merely a rough one, and the efficiency would most probably be much higher with larger masses to be heated. It is interesting to note that while, with increasing mass of material, the surface of the incandescent envelope decreases per unit of metal to be heated, and therefore the rate of loss of heat to the surrounding water is less, on the other hand, the time of heating increases in the same ratio, so that the losses from this cause should remain constant with different diameters, assuming an invariable temperature of envelope. Still another matter which might well receive early investigation is the reason why the nature of the electrolyte used influences the result.

The Gas Engine in Electric Lighting.

The services rendered by the gas engine to electric lighting, says the London *Electrician*, have been extensive and manifold. This engine has not only been used alone, both in public and private plants, but a useful field has been found for it as an adjunct to steam stations. Usually the supplementary gas-engine plant is to be found along with the steam engines in the samest ations, but at Brussels this practice has been modified in an interesting manner by putting the auxiliary gas plant in a separate sub-station situated at some distance from the main station. And in England the India Rubber & Telegraph Works Company, of Silvertown, have recently installed two out of a total of five generating sets, which it is intended ultimately to provide. Each set comprises a 120-hp twin-cylinder gas engine, working on the "Otto" cycle, direct-coupled through Raffard clutches to two dynamos, one at each end of the crank shaft. The set runs at 150 revolutions per minute, and at this speed the dynamo gives a normal output of 320 amperes at 125 volts. One of the features of special interest in this station is the direct-coupling of the gas engines. Such engines have long been adopted in various stations on the Continent, but until recently they had not made their appearance in England.

Central Station Supply Under Difficulties.

During a recent season of low water some ingenious expedients were adopted by Mr. E. B. Newcomb, general manager of the Westbrook (Me.) Electric Light & Power Company, to insure the continuance of its lighting service. The plant is primarily for the supply of light and power to the immense paper manufacturing works of the S. D. Warren & Co., which is situated about a mile below the water-power electrical generating plant, and on the same stream.

During the period of low water the direct-current motors at the mills were run as generators by steam-power, and the current transmitted to the station, running the generators there as motors, and thus supplying sufficient additional power to continue the service to the patrons of the company. A large alternator was also removed to the mills and the current from it returned to the station for distribution.

One especially novel feature was the use of an alternating current on one side of a three-wire continuous-current distributing system, the other side carrying a continuous current. No difficulty whatever was experienced in the operation of this daring expedient.

The Forbes, or Unit of Density.

A correspondent writes that he has read with interest the letter, reprinted in a recent paper, purporting to have been written to the London *Electrician* by certain Japanese commissioners; but points out that there are serious objections to naming the unit of density the *forbes*. On this side of the water, he says, the Forbes is universally considered as a cause of levity, and if the Japanese term comes into use, we shall have the same name applied to a unit and to the motive force of its reciprocal. He therefore suggests that the Japanese either change the name of their unit—or reform Prof. Forbes.

Cost of Arc Lighting in New York City.

The following bids were made on Dec. 2 for supplying arc lights for lighting the streets of New York City during the coming year:

Brush Company, 720 lamps at 40 cents each per night, and 92 at 45 cents each; Madison Square Company, 312 lamps at 40 cents and 10 at 50 cents; Mount Hope Company, 361 lamps at 40 cents; Harlem Company, 212 lamps at 40 cents and 19 at 50 cents; Manhattan Company, 241 lamps at 40 cents; Edison Company, 125 lamps at 50 cents; North River Company, 830 lamps at 45 cents.

The Folsom-Sacramento Company.

The Sacramento Electric Power & Light Company, which recently completed its gigantic water-power plant at Folsom and transmission lines connecting the power plant with distributing plants in Sacramento, has acquired, at a cost of $610,650, the entire street railway system of the city of Sacramento, consisting of over 24 miles of track, with the most modern and approved electrical equipment, fully occupying and amply accommodating the whole city.

The company has secured the contract for street lighting from the city of Sacramento, and has also installed arc and incandescent lights for private consumers, and is supplying motors with electric current already sufficient to earn an excess over all its operative and fixed charges.

The capacity of the present generating plant at Folsom is 4000 hp, of which the transmission plant will absorb 1000 hp, leaving a net available capacity at Sacramento of 3000 hp, of which only 950 hp is being now used in producing the above-mentioned results.

The Chicago Motocycle Contest.

The long-heralded motocycle contest at Chicago for prizes aggregating $5,000, offered by the *Times-Herald*, came off on Thanksgiving Day. Six vehicles entered, four of which used gasoline for power, and two electricity; of these only two, both gasoline motocycles, finished the race, over a course of 54 miles, which, it is stated, was covered with slush and snow, and over ruts that would have tried horses to their utmost. The Duryea Motor Wagon Company, of Springfield, Mass., and H. Mueller & Co., Decatur, Ill., are the makers of the successful machines. The Duryea machine, according to the account of the *Times-Herald*, completed the course in a little over 10 hours' time, or, according to the umpire, in 7 hours and 53 minutes "corrected time": the Mueller machine arrived 1 hour and 35 minutes later, according to the former, or, according to the umpire, was only beaten by 25 minutes.

Following is the report of Mr. Hiram Percy Maxim, the umpire of the Morris-Salom electrobat:

At precisely 9 o'clock the Morris & Salom electrobat, No. 18, received its word to line up for the start. Henry G. Morris, of Philadelphia, occupied the box and H. P. Maxim accompanied him as umpire. The snow at the starting point had been badly cut up by the narrow tires of some of the preceding vehicles, and was anything but smooth.

Messrs. Morris & Salom said they had no intention of running over the entire course, but would simply go over enough of it to demonstrate the commercial practicability of their system. At 9.03 the word to start was given, and, as is usual with these electrically propelled carriages, it started very smoothly and easily, with an entire absence of noise and shaking.

At 10.27, at Thirty-seventh and Michigan Boulevard, where the fresh relay of batteries was on hand, it was deemed advisable to take out the old ones. In exactly five minutes the four little boxes, weighing but 150 pounds each, were exchanged, and the trim little "bat" was off again plowing up the snow. Along the route the public was loud in its approval of the appearance of the vehicle and its absence of noise, jar and bad odors. The absence of noise appeared to also meet the approval of the passing horses, as very few as much as lifted their ears.

At 11.08 the Auditorium Hotel was passed with all well on board, and with no fault to find with anything but the roads, which in many places were well nigh impassable for a self-propelled vehicle. At the grade approaching Rush Street bridge the road was particularly bad. It seemed impossible to ascend it through the huge lumps of ice and the deep snow and slush. The electrobat made a gallant rush at it, and but for a violent jolting as it fell into the melted holes and over the lumps of ice, it paid no attention to the obstruction whatever.

At 12:02 the corner of the Bank Street and the Lake Shore drive was reached and another set of batteries put in. This occupied seven minutes. After continuing on the drive north, the snow was found to be getting deeper and worse, and Mr. Morris, thinking he had proved his vehicle able to stand any road, decided to withdraw and return. Between 10 and 12 miles of very bad roads had been traveled over that would severely tax the running gear of any vehicle, and nothing had loosened or happened to any part of the electrobat. A halt was made, and the vehicle turned and started back cityward. It arrived at 1557 Wabash Avenue at 12:48 without a single stop for anything, and entered the testing rooms proudly on its own power and in good condition. Mr. Morris and Mr. Salom were satisfied with their vehicle, and now know its ability to run anywhere. They simply state that the heavier the road the more the power is required. Mr. Salom, the designer of the electrical equipment of the electrobats, considers his most sanguine calculations exceeded.

Mr. A. A. Bennett, the umpire accompanying the electric motocycle of H. Sturges, made his report as follows:

Our start was made at 9:01 o'clock. East of the Illinois Central tracks on the Midway a stop of one and one half minutes was made. The motocycle was pushed along until Forty-eighth Street and Cottage Grove Avenue was reached. Here a stop of 33 minutes was made to cool field coils, which were very warm. Continuing, the trip was made on Cottage Grove to Indiana Avenue, to Eighteenth, to Wabash, to Harrison, to Michigan, to Rush, to Chicago Avenue and Pine Street. At this point a stop of 15 minutes was made to cool the coils. Another stop of 14 minutes was made on the Lake Shore drive, and shortly afterward two stops of 9 and 10 minutes respectively were necessary. From this point the road was so soft that when stops were made assistance was given the vehicle in starting. Toward the end the road was very soft and much pushing had to be resorted to.

Two hours and 46 minutes were consumed in going from North Avenue to Diversey Avenue, where the race was abandoned at 1:25 p. m., the power being used up. No breaks of any kind occurred, and all seemed to run smoothly.

The Electric Potential Club.

The first annual dinner of the members of the above social and electrical organization was held at Young's Hotel, Boston, last Monday evening, Nov. 25, and was attended by upward of 50 gentlemen. There were several distinguished guests present, including Hon. John R. Murphy, Commissioner of Wires for the city of Boston; Mr. F. E. Barker, of the Board of Gas and Electric Commissioners; Mr. C. S. Sergeant, general manager, and Mr. H. F. Wood, purchasing agent, of the West End Railway Company; Messrs. Raymond and Bennett, of the Cambridge Electric Light Company; Mr. E. I. Garfield, New England manager for the Fort Wayne Electric Company, and several prominent officials of central stations and telephone companies.

Mr. Frank Ridlon, president, did the honors of the occasion and at the conclusion of the dinner, rapping the party to order, introduced the exercises in a brief but appropriate address. Mr. F. M. Kimball, of the General Electric Company, was the first speaker and confined his remarks to the organization, urging those who were not already members to become such at once, promising them both pleasure and profit from na intellectual and social standpoint.

President Ridlon announced several names for membership, all of whom were duly elected.

Col. Raymond, treasurer of the Cambridge Electric Light Company, was introduced, and addressed the club relative to the undue interference of legislators against the rights of private corporations, and as such interference seemed likely to continue, he protested against it in strong and eloquent words, crediting private enterprise and capital as having made Massachusetts what she had become, a fact which people should not forget.

Capt. William Brophy, Assistant Commissioner of Wires for Boston, delivered an able address on "The Insulation of Overhead and Underground Wires." At the conclusion of the address Capt. Brophy was accorded hearty applause.

General Manager Sergeant, of the West End Railway Company, being called upon for an expression of opinion on the address, said that he considered overhead trolley wires about as safe as any kind of wires now in use for electrical purposes. At the same time, whenever a method of propelling street cars is invented that would do away with the entire overhead wire system, no branch of the industry would more warmly welcome and promptly adopt it than electric railways. Mr. I. H. Farnham, electrician of the New England Telephone Company, in alluding to insulation, stated that his company insisted upon having and using only wires insulated in the best-known manner. He was now using a kind that had a strip of thin iron wound around it spirally, which prevented abrasion when passing through trees, but if this type of wire was adopted throughout the entire system of his company it would be more expensive than placing all its wires underground. Mr. W. J. Denver, assistant general manager of the N. E. Telephone Company, was inclined to think that the solution of the problem of dangerous electric wires could be reached by discarding entirely insulation of all kinds. People would then avoid playing with wires and always give them a wide berth. So long, however, as they must have insulated wires only the very best obtainable should be used. Supt. Coughlin, of the Worcester Electric Light Company, on being asked about the working of underground wires, replied that his company had laid about 300,000 feet of ducts, but would not place wires in them before next Spring. They were anxious in Worcester to see and know just how the wire now being buried in Boston would act this Winter.

Superintendent Anderson, of the United Electric Company, of Springfield, related how in that city an underground wire carrying a 1000-volt current was destroyed during the blizzard of 1888. His company, however, had no alternative, as the city would not allow the suspension of such a wire overhead, so another was buried, and since that time no further trouble had been experienced. Mr. J. M. Oxford, assistant general manager of the Boston Electric Light Company, said that his company had been following out Capt. Brophy's policy as indicated in his address. In other towns and cities trouble had been experienced at times, but Boston had been

singularly fortunate. An adequate system of examination and testing had been adopted by his company, which was persistently and regularly carried out. There had been no limit to the money expended in purchasing the very best cables. His company was always ready to listen to suggestions and to adopt them if they were useful. Advice and assistance from the city officials had proven valuable at times, and he considered that the entire system was now as perfect as could be found anywhere. The question of handling the alternating current having been presented he would say that his company was handling such a current successfully. Mr. Sidney Hosmer, also of the Boston Electric Light Company, gave a brief account of the processes of testing made daily over the entire city.

Mr. Bennett, of the Cambridge Electric Light Company, spoke briefly of the commercial aspects of the business. He favored municipalities laying conduits and leasing them to private companies.

Mr. F. E. Barker, of the Gas and Electric Commission, urged closer relations between the gas and electric lighting interests as they ran parallel. Referring to the board and its jurisdiction over so many problems, he said it frequently happened that its decisions appeared like an unjust infliction upon parties most interested, but he felt assured sooner or later the community would appreciate that the commissioners were watchful of interests, from both the public and corporation standpoint. Mr. G. W. Blodgett, electrician of the Boston & Albany Railway, mentioned instances of trouble caused in electric signal systems by defective insulation. This virtually concluded the discussion of the evening, and after a vote of thanks to Capt. Brophy the meeting adjourned, the general impression being that the clubs had opened very successfully the Winter meetings. It is probable that an arrangement will be affected with the Institute of Technology and Boston Society of Arts by which the club may have the use of their rooms when addresses are delivered requiring the use of electrical apparatus. Such an arrangement will have the approval of Gen. Francis A. Walker, and a committee from the club was appointed to confer further regarding the arrangements.

Recording Railway Test Instruments.

At the October meeting of the Franklin Institute, Prof. Hermann S. Hering described a recording ammeter and voltmeter used in some street railway tests, an account of which recently appeared in the *Electric Railway Gazette*. The instrument consists of a Weston apparatus, in which the needle moves over a sharp metallic edge, with a strip of paper sensitized with calcium chloride between the needle and the sharp edge of the metal. One terminal of a small induction coil is connected to the needle, the other to the metallic edge, and the record is made by the spark in its passage through the paper from one to the other.

The National Electrical Exposition Company.

The electrical exhibition to be held next May at the Grand Central Palace during the nineteenth convention of the National Electric Light Association, will be in the hands of a company incorporated for the purpose under the name of the National Electrical Exposition Company.

The officers of this company are Harrison J. Smith (superintendent of the Edison Illuminating Company of New York), president; Wm. F. Weiss (vice-president of the New York Steam Company), vice-president, and George F. Porter (secretary of the National Electric Light Association), secretary and treasurer. The executive committee, which is the governing power of the company, is composed of H. J. Smith, C. O. Baker, Jr., R. B. Corey, H. L. Lufkin, E. F. Peck. The board of directors consists of H. J. Smith, C. O. Baker, Jr., John A. Seely, R. B. Corey, W. A. Stadelman, H. H. Harrison, H. L. Lufkin, W. F. Weiss, J. W. Godfrey and E. F. Peck. The stock has all been subscribed for and 10 per cent. of its capital paid into the hands of the treasurer.

The New York Industrial building (Grand Central Palace), which has been secured for the exhibition hall, occupies the block bounded by Forty-third and Forty-fourth Streets, Lexington Avenue and Depew Place, and was constructed expressly for trade exhibitions. It has seven stories with roof garden, is lighted from a plant of 5000 incandescent lights, and has a spare steam plant of 300 hp. The lighting companies of New York can also supply direct or alternating currents to exhibitors, and two gas companies can furnish gas through two four-inch mains.

The company is now prepared to receive applications for space. All communications should be addressed to the executive office of the company, at 136 Liberty Street, New York City.

Two Forms of Dry Battery.

In an article printed in a recent issue of the London *Electrical Engineer*, Mr. J. Warren describes several modifications of the Leclanché primary battery, two of which we illustrate herewith. Fig. 1 is a sectional view of a dry cell which Mr. Warren designates as the E. C. C. battery, and Fig. 2 similarly represents the Hellesen dry cell. The former cell consists of a zinc vessel, *D*, forming one electrode and containing a black paste, *B*, in which is embedded the carbon electrode, *A*, and a white paste, *C*, surrounding the black paste. The formula for the black paste is as follows:

	Per cent.
Manganese dioxide	7.57
Carbon	47.26
Magnesia	7.20
Lime	1.40
Peroxide of iron	2.12
Ammonia	12.78
Water	9.77
Ingredients not determined	11.90

That for the white paste is:

Lime	20.89
Ammonia	20.29
Chloride	6.31
Water and binding material	52.51

A thin layer of silicate cotton, *F*, is placed over the pastes and the cell is sealed with a layer of pitch, *G*. A waste tube, *F*, is provided

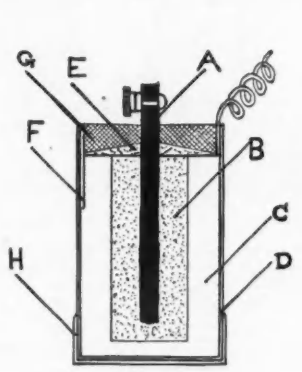


Fig. 1.

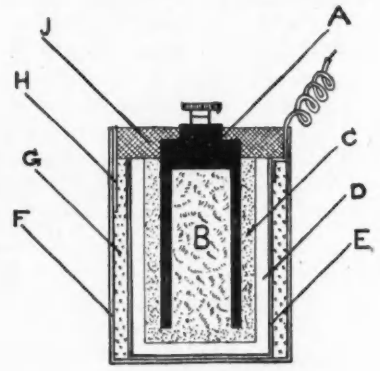


Fig. 2.

to facilitate the escape of gas. The Hellesen cell (Fig. 2), is very similar to the above; the zinc jar or vessel, *E*, is this case, however, is contained in a pasteboard cylinder, *F*, and surrounded by sawdust packing, *G*. The carbon electrode, *A*, is made in the form of an inverted cylinder, and the interior is filled with silicate cotton, *B*. Around the outside of the carbon cylinder is placed a paste, *C*, made up as follows:

	Per cent.
Manganese dioxide	25.54
Carbon	16.02
Silicate	12.76
Magnesia	12.88
Lime	0.96
Peroxide of iron	3.46
Moisture and ingredients not determined	28.38

Next comes a layer of white paste, *D*, of which the following is an analysis:

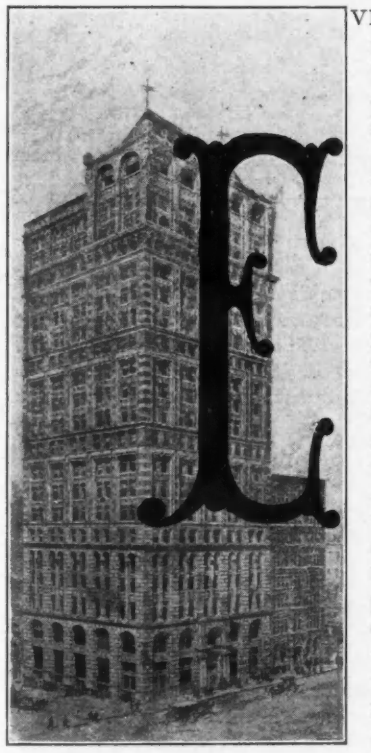
	Per cent.
Lime	26.18
Oxide of zinc	6.00
Magnesia	0.51
Ammonia	2.49
Water and binding material	64.82

This white paste forms a lining to the zinc cylinder, *E*, which is, of course, the negative electrode. A stout wire is soldered to the zinc cylinder to form a terminal, and the carbon is also provided with a brass terminal screw and nut. A waste tube, *H*, is provided, and the whole is sealed with pitch, *J*.

Invention of the Electromagnetic Telegraph.

Owing to a delay in the mails, the manuscript of the concluding article in the "Invention of the Electromagnetic Telegraph" series arrived too late for use in the present issue, and will appear next week.

The Electric Lighting Plant of the American Tract Society's Building.



EVERY well-ordered office building now has its own lighting plant, but many of these are so poorly arranged, and designed with so little forethought, that a description of a really good one is always acceptable. The electric lighting plant of the American Tract Society's new building, while by no means a large one, is extremely well-arranged, and possesses many features which could be profitably copied. The plant derives its power primarily from two 125-hp Root water-tube boilers, banked into a battery, and one 250-hp Root boiler, worked singly, supplying steam at a pressure of 120 pounds. The boiler plant averages six tons of coal every 10 hours. From the boilers the steam passes into a particularly well arranged system of steam piping. There are no valves outside of the engine room, and all of these are conveniently placed. The engines all draw steam from a common large main through steam separators. The piping system is wholly covered, to minimize loss by heat radiation. The generating plant consists of McIntosh & Seymour engines, directly coupled to General Electric slow-speed multipolar generators, and so silently and sparklessly do they run that unless one actually sees the parts in motion, it is hard to believe that the machine is

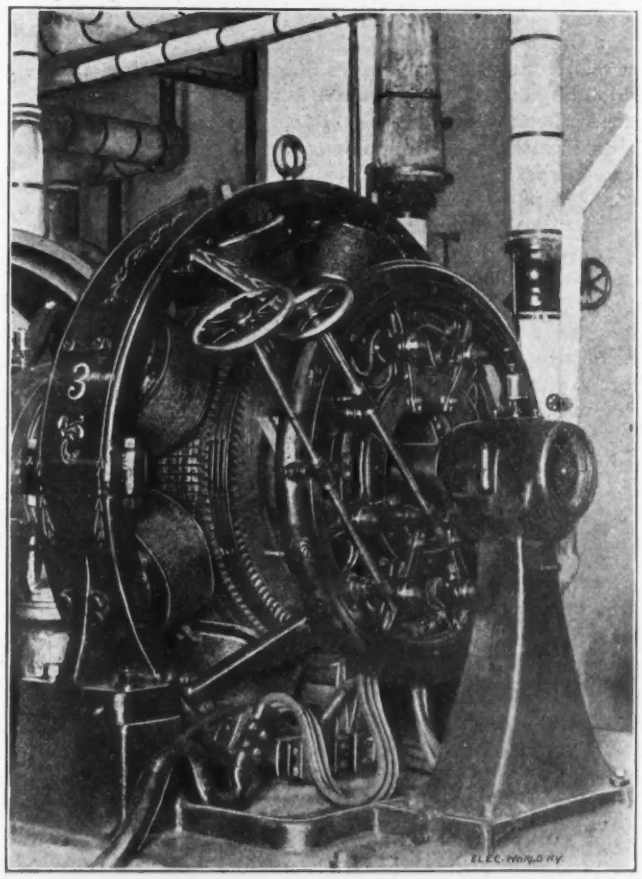


FIG. 1.—SHOWING COMMUTATOR AND BRUSH ADJUSTMENT.

moving. There are three units, one of 100, one of 50 and one of 25 kw. Thus it is possible, by steps of 25 kilowatts, to meet the load economically up to the full capacity of the plant. The armatures of the generators are multiple-wound and cross-connected, so that there are as many brushes as poles; the armature windings have spiral connectors, and are, therefore, quite compact. Gauze brushes are used, and are found to work excellently; the brush adjustments, both for pressure and position, are made by means of hand wheels. The total load that will be carried by the plant at present is 2,650 incandescent lights, working at 116 volts, and four arc lamps on the roof of the building, consuming 100 amperes, so that, as will be readily seen, a large margin of power is available.

The switchboard is divided into three large panels, two side panels for ordinary circuits, and a centre panel, which is shown in Fig. 3. At the base of this panel is a three-pole, double-throw switch with

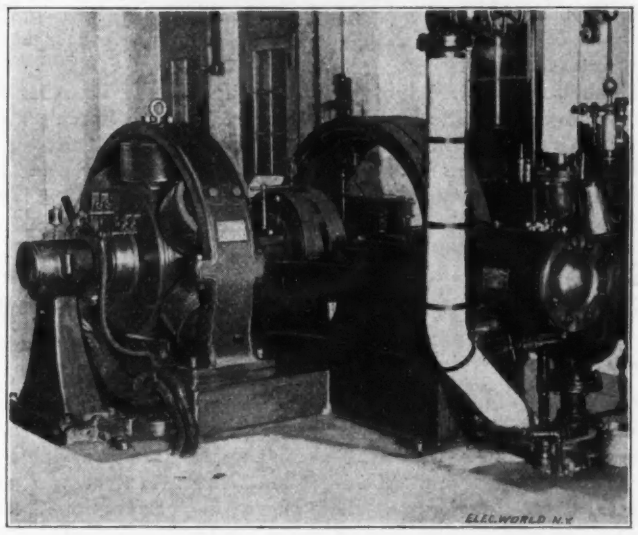


FIG. 2.—A GENERATING SET.

multiple jaws, which throws the whole plant on to the Edison mains should it become desirable. The building is wired on the three-wire system, with a neutral equal to the sum of the outer wires, and when connected in on the city service the wiring is used on the ordinary three-wire plan, but when current is furnished by the plant in the

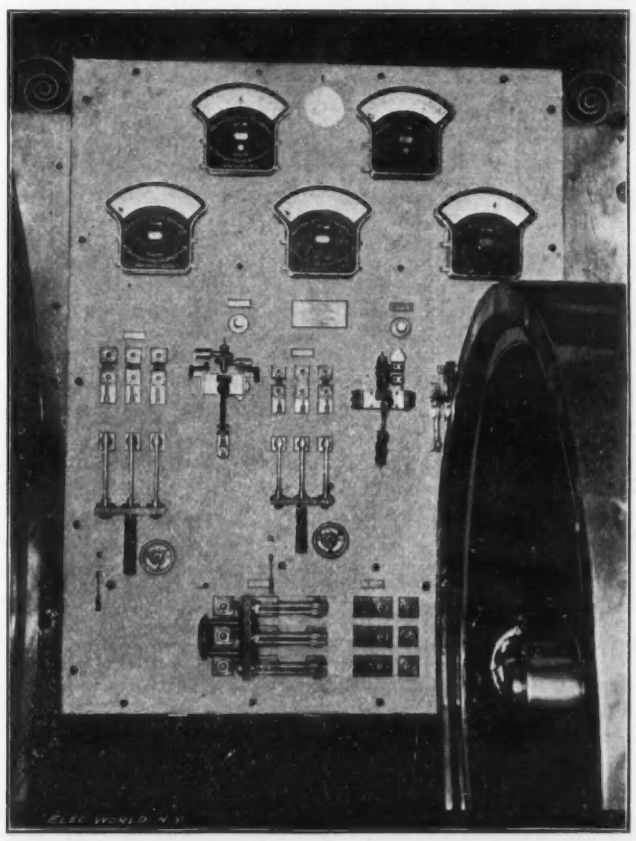


FIG. 3.—CENTRAL SWITCHBOARD PANEL.

building, the two outer wires are run at the same potential, the neutral forming a common return. Every dynamo is provided on the central panel with a main switch, a field switch, a rheostat and an automatic circuit-breaker. The board is provided with Weston

instruments as follows: An ammeter for each machine, a totalizing ammeter, a voltmeter, a ground detector and a differential voltmeter; these are symmetrically arranged on the marble panels. The circuit switches divide the building into four sections, and each switch controls its section through five floors. The hall lights are on separate switches, and one switch controls half the hall lights through five floors, taking alternate chandeliers as the circuits proceed upwards. The twenty-third floor is on a separate switch, as are also the arc lights on the roof. The arc light circuit has a separate circuit-breaker; the lamps are operated two in series, each pair passing 50 amperes.

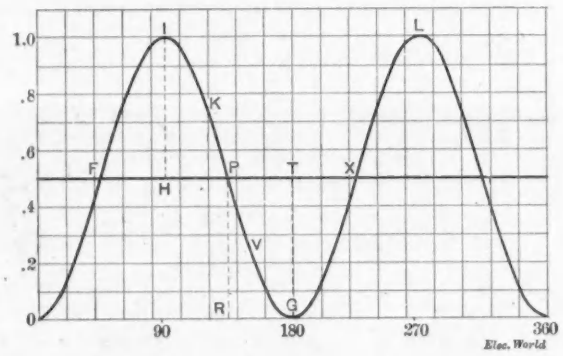
All of the circuits are marked on a neat brass plate mounted above the switchboard. The rear of the switchboard is fenced in by a wire-work enclosure with sliding doors, so that only the proper parties may have access.

The building is wired throughout with iron-armored interior conduit, and every circuit carrying five lamps or more is fused. There are no fuses whatever in the chandelier branches. At suitable intervals slate-lined fuse boxes are built into the wall. The fuse contacts are mounted on a single panel in the bottom of the box, especially designed for this purpose. The Tucker Electrical Construction Company installed the entire system.

The Loss of Energy in Changing from a Single Alternating Current to Polyphase Currents.

BY R. A. FESSENDEN.

One great difference between simple alternating and polyphase circuits, as has been pointed out by a number of electricians (more particularly by Mr. Steinmetz) is that in the former systems the flux of energy is intermittent and in the latter it is steady. Consequently, if we transform a single alternating current into a polyphase current, we must have a means of storing up some of the energy during one part of the phase so as to deliver it to the circuit during the remainder. Since, as we shall see, the amount of energy so stored is a considerable fraction of the whole work of the circuit,



SIMPLE ALTERNATING CURRENT CURVE.

it is necessary that the means used to store it should be an efficient one.

One method which has been proposed is that in which a transformer and a condenser are used. The losses inevitable to this method may be calculated as follows:

In a monophase circuit let the voltage at any instant be E_{max} sin ωt. For convenience let current and voltage be in phase, then the current will be $I_{max.}$ sin ωt. The instantaneous power will then be $E_{max.}\ I_{max.}\ \sin^2 \omega t$. If $E_{max.}\ I_{max.} = 1$ kilowatt, then the power at each part of the phase is shown by the curve *OIGL* in the accompanying diagram.

The average power in the circuit is $\frac{E_{max.}\ I_{max.}}{2}$. This is shown by the straight line *HPTX*. But the power taken by the polyphase circuit, if two-phase, is $E'I' \sin^2\omega t + E'I' \cos^2\omega t = E'I' (\sin^2\omega t + \cos^2\omega t) = E'I'$.

That is, the power does not depend upon ωt, but is constant and it must therefore be also represented by the straight line *HPTX*. So that between $\omega t = 45°$ and $\omega t = 135°$ the monophase circuit delivers the energy represented by the area *FIPH* in excess of that absorbed by the polyphase circuit, this energy being stored up in the iron of the transformer and in the dielectric of the condenser. Between the limits $\omega t = 135°$ and $\omega t = 225°$ the monophase circuit fails to furnish the energy demanded by the polyphase circuit, and this deficiency is supplied by the condenser and transformer. By symmetry we see that half of this energy, an amount equal to the area *TGX*, is supplied by the transformer. This equals

$$\frac{\pi}{8} - \int_{180°}^{225°} \sin^2 \omega t \ d(\omega t) = .25$$

Since the total energy generated during the half phase is $\frac{\pi}{2}$, 15.9 per cent. is supplied by the transformer.

The energy stored in the iron is $\frac{\mathfrak{H}\mathfrak{B}}{2} = \frac{a\,\mathfrak{B}^2}{2(1-b\,\mathfrak{B})}$.*

That lost by hysteresis per half cycle is $\mu\,\mathfrak{B}^{1.6}$. Therefore, the ratio of the energy lost to that stored is $\frac{a\,\mathfrak{B}^2}{\mu\,\mathfrak{B}^{1.6}\,(1-b\mathfrak{B})}$. (The amount of hysteresis for a half cycle is taken because the energy is stored twice per cycle).

In a good brand of iron used for transformers the constants were, $a = 0.006213$, $b = 0.00005605$ an $\mu = 0.0022$.

For a gaussage of 5000 we have for the efficiency, on substituting the value of the constants, 75.4 per cent. Therefore the percentage of the total power which is lost in the transformer by hysteresis alone is $\frac{(15.9 \times 24.6)}{75.4} = 5.18$ per cent. We must also allow about 2 per cent. for eddy current losses, and 1 per cent. for copper losses.

The efficiency of a commercial condenser is nearly 97 per cent.† The loss due to this would therefore be

$$\frac{15.9 \times 3}{97} = 0.49 \text{ per cent.}$$

The total losses due to the method used, aside from other losses in the motor itself, will be 8.67 per cent. Hence we see that this method, no matter how perfect it may be in other respects, must always be handicapped to such an extent as to render its use impossible where fairly large units of power are required.

It would therefore appear that a better method of making this conversion would be to devise a method in which the power is stored up in the momentum of the armature itself. Since, however, the armature has no momentum at the instant of starting, it must work differently while coming up to speed from what it does when running normally. I believe that it is not impossible to devise such a method.

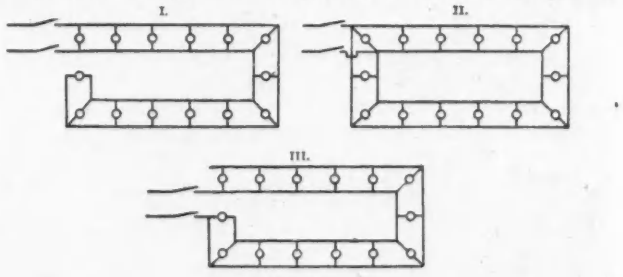
Formulas for the Calculation of Return Loop Circuits.

At the October meeting of the Franklin Institute, Mr. Edwin R. Keller read a paper on the return loop system of wiring, in which, after pointing out that an absolute uniformity of potential cannot practically be attained by this system, discusses which of several of its modifications will give the most satisfactory results in a specific case considered.

In the lighting of halls, lecture rooms, theatres, etc., it frequently occurs that single lamps are distributed around the cornices, the whole circuit being controlled by a single switch. In this case architectural considerations usually require that the lamps be spaced evenly. The electrical problem is then, how to wire in order to secure a minimum variation of potential at the lamps at the least expense for copper and conduit.

There are three methods of wiring, illustrated in the accompanying diagram, which may be applied to cases of this kind. The first method is simply the ordinary parallel system of distribution. In the second, the loop closes on itself, so that the current is divided where it enters the circuit, one-half flowing in either direction.

The third, or return loop method, is similar to the first, except that the mains are run in opposite directions, so that the fall of potential



WIRING PLANS.

is a maximum on the one where it is a minimum on the other. At first sight, it would appear that the potential at all the lamps would be the same, and if this were the case, it would be sufficient to use a very small wire. That it is not, will appear presently from the formulas.

*See THE ELECTRICAL WORLD, Aug. 14, 1895.
† Bedell, Am. Inst. E. E., Oct. 18, 1893.

Let c = current per lamp.
r = resistance per unit (foot) length of wire.
l = length of wire between any two lamps (single distance).
n = total number of lamps in the circuit.
E = the fall of potential.

In the first method the maximum difference in potential between any two lamps is evidently equal to the total drop to the last lamp on the circuit. The drop from the first to the second lamp is

$$2\,rlc\,(n-1)\,;$$

from the second to the third,

$$2\,rlc\,(n-2)\,;$$

from the $(n-1)$th to the nth,

$$2\,rlc.$$

Hence the total drop to the last lamp,

$$E = 2\,rlc\left[(n-1) + (n-2) + \ldots (1)\right]$$
$$= rlc\,(n^2-n)\,; \qquad (1)$$

and the resistance per unit length of wire, which will give this maximum variation, E, is

$$r_1 = \frac{E}{lc\,(n^2-n)}. \qquad (2)$$

In the second method the current is simply divided into two halves, one half flowing around each half of the circuit. Hence it is merely necessary to substitute $\frac{n}{2}$ for n in the above formulas, or

$$E = \frac{rlc}{4}(n^2-2n) \qquad (3)$$

and

$$r_2 = \frac{4E}{lc}(n^2-2n). \qquad (4)$$

In the return loop system the drop to any lamp, say the x th from either end is, plainly,

$$E_x = lrc\left\{\left[(n-1) + (n-2) + \ldots (n-x+1)\right] + \left[(n-1) + (n-2) + \ldots (x)\right]\right\},$$
$$= \frac{lrc}{2}(n^2 + 2nx - 3n + 2x - 2x^2)\,; \qquad (5)$$

from which it is evident that the drop is not independent of x, and hence different at every lamp. Differentiating (5), we find it a maximum when

$$x = \frac{n+1}{2}.$$

this is, in the middle of the circuit. The maximum drop is, consequently,

$$E_{max.} = \frac{lrc}{4}(3n^2-4n+1), \qquad (6)$$

which is a minimum when

$$x = n \text{ (or } 1)\,;$$

that is, at either end of the circuit. Hence, substituting in (5) we have for the minimum drop,

$$E_{min.} = \frac{lrc}{2}(n^2-n). \qquad (7)$$

This last equation might have been derived directly from (1), for, evidently in the return loop system, the drop to the first or last lamp is equal to one half the drop to the last lamp in the first system.

If now we subtract (7) from (6), we will obtain the greatest variation of potential between any two lamps in the circuit.

$$E = E_{max.} - E_{min.} = \frac{lrc}{4}(n^2-2n+1), \qquad (8)$$

and

$$r_3 = \frac{4E}{lc\,(n^2-2n+1)}. \qquad (9)$$

We can now compare the relative economy of the three systems. The amounts of copper required are inversely proportional to the resistances, and hence, if we call a_1, a_2, and a_3, respectively, the circular mils required in the three different systems to produce the same maximum variation in potential, E, we have, from (2), (4) and (9):

$$a_1 : a_2 : a_3 = \frac{1}{r_1} : \frac{1}{r_2} : \frac{1}{r_3} = 4\,(n^2-n) : (n^2-2n) : (n^2-2n+1).$$

From this it appears that while the ordinary parallel system requires more than four times as much copper as the closed loop, there is very little difference between the closed loop and the return loop, though there is a slight advantage in favor of the second (closed loop) system. It must be remembered also that this comparison is made on the basis of a fixed maximum variation in potential between two lamps of the circuit, and not maximum total drop. From a consideration of the same total drop, the advantage in favor of the closed loop would be much greater. The amounts of copper would then be, from (2), (4) and (6):

$$a_1 : a_2 : a_3 = 4\,(n^2-n) : (n^2-2n) : (3n^2-4n+1).$$

The following example will illustrate the use of the formulas and show the results which would be attained in an actual practical case:

In a lecture room having 100 (110-v. 16-cp) lamps in five circuits, with a distance between the lamps of 10 feet, and a maximum allowable variation of one volt between any two lamps, the resistance, by the ordinary parallel system, would be, from (2),

$$r_1 = \frac{1}{10 \times .5\,(20 \times 20 - 20)} = .00053 \text{ ohms},$$

which corresponds to a No. 7 wire (B. & S. gauge).

By the closed loop system it would be:

$$r_2 = \frac{4\,(20 \times 20 - 20)}{(20 \times 20 - 40)} \times .00053 = .00222 \text{ ohms},$$

which corresponds to a No. 13 wire.

And by the return loop system

$$r_3 = \frac{4\,(20 \times 20 - 20)}{(20 \times 20 - 40 \times 1)} \times .00053 = .00221 \text{ ohms},$$

which also corresponds to a No. 13 wire.

By the first two systems, however, the total drop would be but one volt, while by the return loop system the difference between the maximum and minimum would be equal to that amount. The drop to the first lamp would be, from (7),

$$E_{min.} = \frac{10 \times .00221 \times .5}{2}(20 \times 20 - 20)$$
$$= 2.09 \text{ volts}$$

and the drop to the middle of the circuit, from (6),

$$E_{max.} = \frac{10 \times .00221 \times .5}{4}(3 \times 20 \times 20 - 4 \times 20 + 1)$$
$$= 3.09 \text{ volts}.$$

The same size wire in the second system gives a total maximum drop of one volt, and in the first system, from (1)

$$E = 10 \times .00221 \times .5\,(20 \times 20 - 20)$$
$$= 4.18 \text{ volts}.$$

In other words, for the same maximum variation in potential in the three systems, the weights of copper would be, roughly, 208 : 52 : 52 ; and the total drop, 1 : 1 : 3.09 ; while for the same weights of copper, the maximum variations in potential would be, 4.18 : 1 : 1, and the total drop, 4.18 : 1 : 3.09.

Formulas for Winding Magnets.

BY I. A. TAYLOR.

The following method can be used for finding the size and number of turns of wire on a magnet:

Let θ = temperature (Centigrade) of magnet above the air (taken at 25° C.)
p_1 = perimeter of core outside of core insulation, in inches
p_2 = " " coil inside of coil covering, in inches
Z = ampere-turns in one coil
R = resistance of one coil, in ohms
E = volts on one coil
T = turns on one coil
w = watts used in coil
l = length of coil, in inches
d = depth of coil between core insulation and cover, in inches
s = surface for radiation, in square inches
v = cubic inches in coil (not including core, core insulation or cover,
A = circular mils, section of bare wire
a = twice thickness of cotton covering in mils
10.5 = resistance of mil-foot of copper wire at 25° C.
.004 = temperature coefficient per degree centigrade.

VALUES OF a IN MILS.

B. & S. Gauge.	Single Cotton Covering.	Double Cotton Covering.
00 to 5	18	36
6 and 7	16	32
8	14	28
9	12	24
10 to 12	10	20
13 and finer	9	18

The expression for heating is $\theta = \frac{124\,w}{s}$; θ varies in practice between 10° and 75°, the latter being about the limit of safety. Owing to the insulation between layers the wire will take

up a space equal to the square of its diameter outside of the cotton covering.

We have given p_2, Z, E and θ; l is given or assumed, but may have to be changed in case the coil is very much out of proper proportions. Assuming d gives p_2, v and s,

$$A = \frac{Z\,(1+.004\theta)}{2.285\ E}\ (p_1+p_2) \qquad (1)$$

Having found the section A, select the nearest gauge number, remembering that Z varies as the section, and use that value of A in the following equations:

Having assumed d, if

$$s\,v \gtrless \frac{E^2}{7050\ (1+.004\theta)\theta}\ (A+a\sqrt{A})^2, \qquad (2)$$

the value of d, which we assumed is also too large or too small, and a new value should be tried such that $s\,v$ will be within about 10 per cent. of

$$\frac{E^2}{7050(1+.004\theta)\theta}\qquad (A+a\sqrt{A})^2.$$

This difference of 10 per cent. is very small, as it merely affects θ in equation (1), the reason being that if, for example, the assumed value of d is a little too large, the actual value of θ will be slightly below that decided upon. Equation (1) shows that 5° difference in θ makes a difference of only 2 per cent. in A.

Expression (2) is deduced as follows: d must be given such a value that $w=\frac{\theta s}{124}$. Now $w=\frac{E^2}{R}$, and substituting the value of R as given in the equation (3) we have $\frac{E^2\,(A+a\sqrt{A})^2}{(+.004\theta)\ v\ 875{,}000}=\frac{\theta s}{124}$; multiplying each number by $\frac{124\,v}{\theta}$, $v=\frac{E^2}{7050\ (1\ +\ .004\,\theta)\ \theta}(A+a\sqrt{A})^2$ as the equation which must be satisfied in order that d shall be *exactly* right. As explained above, the members neednot exactly equate.

$$R = \frac{875{,}000\ v\ \ (1\ +\ .004\ \theta)}{(A\ +\ a\sqrt{A})^2} \qquad (3)$$

$$T = \frac{l\ d\ 10^6}{(a\ +\ \sqrt{A})^2} \qquad (4)$$

Any expressions for R and T which do not embody a are in very serious error.

$$w = \frac{E^2}{R} \qquad (5)$$

w is large or small, according as the value we gave θ is high or low.

It may be remarked that when deciding the gauge number, after A has been calculated, it is best, with wires finer than 25 B. & S. gauge, to take the size larger rather than the size smaller than that calculated, as A is liable to be reduced by the tension used in winding.

Let us take an example of a circular core magnet wound with cotton-covered wire, in which the following values are given:

$p_1 = 2\pi$; $\theta = 60°$; $Z = 2000$; $E = 10$; and $l = 5$.

Equation (1) then reduces to $A = 108.5\ (2\pi + p_2)$

Expression (2) then reduces to $s\,v \gtrless .000191\ (A + a\sqrt{A})^2$.

Let us assume one or two values of d and tabulate the results:

$d = .2$ inch, then

$p_2 = 2.4\,\pi$; $v = 2.2\,\pi$; $s = [2\ (1.2)^2 + 5 \times 2.4]\,\pi \qquad 14.88\,\pi$.

A (nearest size B. & S. gauge) = 1624 c. m.; $a = 9$.

Expression (2) becomes $323 < 754$, which shows that the assumed value of d is too small.

$d = .4$ inch, then

$p_2 = 2.8\,\pi$; $v = 4.8\,\pi$; $s = [2\ (1.4)^2 + 5 \times 2.8]\,\pi = 17.92\,\pi$.

A (nearest size to B. & S. gauge) = 1624 c. m., $a = 9$.

Expression (2) becomes $850 < 754$, which shows that d should be a trifle less than .4 inch, probably .37 inch; or approximately half a layer; .4 inch, however, is near enough for practical purposes. Concluding the above table we find that $w = 24.1$; probable value of $\theta = 53$ degrees C.

Owing to the uncertainties in connection with the heating, θ is about as likely to be 60 degrees as 53 degrees. In case it did become 60 degrees, .4 inch would be *exactly* right. If, however, θ became 53 degrees, we should find, by a very close calculation, that Z will only be about 2 per cent. above its given value of 2000.

Of course, other wire gauges than the B. & S. gauge should be used when their value more nearly coincides with the calculated value of A. If this formula is to be used for circular core magnets, time will be saved by condensing the foregoing equations.

Hydro-Electrothermic Heating.

BY PAUL HOHO.

Electricity has already furnished us the means of communication, lighting, transmission of power and metallurgic reduction, and for some time the problem of its employment as a means for the production of heat for industrial purposes has occupied attention, and results more or less satisfactory have been obtained by several systems. It is this latter application—the production of heat by the direct conversion of electrical energy—which forms the subject of this article.

The means employed to transform electrical energy into heat energy consists always in the introduction into an electrical circuit of a resistance which, on the passage of the current, becomes a seat of development of heat, localized at the point of resistance, and of a quantity dependent upon the energy in watts absorbed.

Systems for the Electrical Production of Heat.—The following systems have been applied in practice with more or less success:

1. The electrical furnace for the metallurgical reduction of minerals such as those of Siemens, Cowles, Parker and others. In practice these furnaces depend for their operation upon the passage of an arc through the mineral to be reduced, contained in a refractory receptacle, an electrolytic action also occurring, which facilitates the process of reduction. The air contained between the particles and the opposite electrodes constitutes the resistance in the circuit which causes the production of heat. A direct current of considerable E. M. F. and a large intensity is requisite in this system.

2. The employment of the heat of the electrical arc operating upon the metal or material to be treated and permitting a local fusion to be obtained. This system has been elaborated by Meritens, Werdemann, Benardos, Howells and others, and it is generally known under the name of the "Benardos process." Its application is restricted, but a number of installations are operated with success in England. In this system the layer of air through which the arc passes constitutes the heat-producing resistance. A continuous-current of at least 150 volts and of a considerable intensity—100 amperes or more—is necessary to apply this system with success.

3. The employment of extremely large currents with a small E. M. F., the current being made to pass through metallic pieces to be heated, and held in contact one against the other by pressure. The surface of contact is the point of resistance where the action of the heat commences, and as the resistance increases with the temperature, the metals in contact are rapidly carried to a welding or melting temperature; by joining them through pressure, which is often done automatically, these pieces are welded. This is the Thomson system, which has been put in practice in England and is considerably employed in America. This system requires the use of an alternating current which, by means of a transformer forming part of the welding apparatus, produces a secondary current of a very small E. M. F., and of large quantity. For ordinary operations, primary currents of 300 volts and 100 to 150 amperes are employed.

4. The hydro-electrothermic system, which will here be specially considered, is based on a little known action and has a very great value in certain branches of industry. The disposition employed consists of an electrolytic bath into which an electric current of considerable E. M. F. is led, passing from the positive pole which forms the boundaries of the bath and presents a large surface to the electrolyte and thence to the negative pole, consisting of the metal or other material to be treated, and which is of relatively small dimensions.

Through the electrolytic action hydrogen is rapidly evolved at the negative pole and forms a gaseous envelope around the pole; as the gas is a very poor conductor of electricity, a large resistance is thus introduced in the circuit, entirely surrounding the object to be treated. The electrical current in passing through this resistance develops thermal energy and this is communicated to the metal or other object which forms the negative pole. It is its striking character which constitutes the novelty and the essence of the hydro-electrothermic system. To see a piece of iron or other metal plunged into a jar of liquid apparently inert, and immediately become surrounded by a flame and be carried in a few seconds to a welding or melting temperature, is sufficient to attract the interest of even the most indifferent and uneducated spectator.

History of the Invention.—Before treating the technical applications of this system brief reference will be made to the history of its development. The known researches relating to the phenomena which constitutes the basis of the system are not numerous. Davy,

Hare, Foucault, Grove, Gassiot, De la Rive, Wartmann, Despretz, Van der Willingen and others all observed from 1840 to 1880 that if metal wires of a very small diameter were plunged into an electrolytic bath and there formed an electrode, luminous phenomena were produced. Planté, after his invention of secondary batteries, and about the commencement of 1875, first showed, noted and explained both the calorific and the luminous effects. He carried his experiments on the phenomena to a voltage of more than 1500, and based upon them his theory of globular lighting. Slouginoff in 1880 and Colley in 1881 repeated these experiments. Violle and Chassagny in 1886 made experiments with platinum wire one one-hundredth of an inch in diameter immersed as a negative electrode in a solution of sulphuric acid in order to measure the fall of potential at the contact of this electrode and obtained some data which they recorded with care.

The scientific knowledge of the phenomena was in this state when Messrs. Hoho and Lagrange obsérved the phenomena and, being able to find few scientific notes on the subject, commenced the study of the question ; they gradually established the details of the phenomena presented, giving a precise explanation of it as due to the gaseous envelope and developed the subject in a practical way.

Scientific Description of the System.—The phenomenon produced can be briefly described as follows : If a negative electrode of relatively small surface to that of the positive electrode is plunged in any liquid employed as an electrode and the E. M. F. of the circuit is gradually increased, the different phases of the phenomenon presented are : First, ordinary electrolytic action up to three volts, depending upon the nature of the electrolyte employed; second, from three to 30 volts ; ebullition and movement of the liquid around the electrode, with small sparks and regular current ; third, from 30 to 80 volts ; ebullition, a more constant luminous appearance around the electrode and gaseous envelope more or less adherent, the current being very irregular ; fourth, the luminous phenomena become stable and the current constant, but considerably diminished in quantity on account of the resistance of the gaseous envelope, which is now stable completely surrounds the electrode ; fifth, when the E. M. F. is increased, other things being equal, the heating action becomes more intense, and the most refractory substances are easily melted.

The heating action is modified by the extent of the surface of electrode immersed and exposed to the action of the electrical current. The positive electrode can be of any material which conducts electricity, and the electrolyte can be any conducting liquid solution. The phenomena are produced in every case exactly in the manner above described.

When aqueous solutions are employed and the temperature reaches about 90 degrees C, the action is affected by the production of vapor from the water. In practice the temperature of the bath should not be permitted to exceed 60 to 70 degrees C. Certain liquids, such as glycerine, permit the development of a given quantity of heat with an electromotive force and an expansive of energy less than with water. Ordinarily, such a liquid can be rendered conducting, by the addition of a solution of salt or acid.

Two very remarkable circumstances connected with the action of the system, both of which give promise of playing an important role in its application, may be described as follows :

First, If any portion of an object forming the negative electrode is insulated, the part thus protected is entirely unaffected. Through this, local heating can be done, of a character impossible with any other system.

Second, If an object of relatively small dimensions, immersed in the bath, is approached to the negative electrode, but without touching it, an arc or something of that nature is formed between them ; a luminous gaseous envelope then forms around the entire surface of the object (if the E. M. F. of the circuit is sufficient) which is submitted to the heating action in the same manner as if it constituted the direct pole of the circuit.

A similar action, but producing a different result, occurs if the object to be treated becomes a positive instead of a negative pole, the oxygen developed acting as a strong oxydant. When alternating currents are employed, the phenomena in general are the same.

Practical Application of the System.—The special apparatus necessary for the application of the hydro-electrothermic system is very simple and inexpensive. It consists of a receptacle about 24 inches deep and 32 inches in diameter ; if not of metal, the interior wall is covered with a metallic lining, which forms the positive electrode of the circuit. The receptacle is filled with a conductive acid, neutral or saline aqueous solution of more or less density, which constitutes the electrolyte in which the action is produced. Besides the above, there is only necessary a simple pair of insulated tongs, by means of which the piece of metal or other object to be treated is held. The tongs are connected to the negative pole of the circuit.

The electrical energy can be obtained from any source, as from a dynamo or a battery of accumulators. The dynamo ought to be of the shunt or compound type, and the circuit should be under the control of the operator by means of a cut-out switch placed near the bath.

The energy necessary depends upon the extent of the surface of the object immersed in the electrolyte and exposed to electrical action. Practice has shown that the E. M. F. most suitable is in general from 125 up to 200 volts as a maximum. The application of from 35,000 to 40,000 watts during 30 to 50 seconds will easily bring the two ends of a bar of iron 1½ inches in diameter to a welding temperature, and heat a surface of from 7½ to 9 square inches in the same length of time.

Instead of a dynamo alone, it is generally preferable in practical work on a large scale to employ a storage battery in parallel with a dynamo.

Industrial Applications.—To utilize in the best manner an installation and make it produce the best results, it is evident that its continuous operation is required, and experience has shown that this can be easily attained in most works where the system may be employed because of the various applications of which it is capable, Of the Thomson system, with which it can be compared, this is not the case, for, on account of the special character of the apparatus employed and of its method of operation, it cannot be used except for a very limited variety of work, and therefore is only remunerative for special work, and that on a very large scale.

For the same reason the application of the Benardos system is very limited, and unless special work for which it is suitable can be obtained in sufficient quantity, its use is likely not to prove remunerative.

The hydro-electrothermic system, on the contrary, is applicable to such a large number of uses, and requires an expense so small for the modifications necessary for any particular special work, whatever it may be, that having once unstalled the generating plant a large field is opened; that the plant may be kept fully employed can be seen from the following partial enumeration of its uses: One degree, heating of pieces of metal for welding, stamping, forging, etc.; two degrees, tempering, hardening, etc., of tools and other steel objects; three degrees, cleaning metal surfaces; four degrees, brazing, soldering, etc.; five degrees, electro-chemical fusion and reduction.

Welding.—An installation of 45 kws capacity, which can be taken as a type, will be sufficient to heat pieces up to 10 inches in diameter in 40 seconds, ready for the anvil. One bath will keep two forging gangs at this work. Under these circumstances, notwithstanding the cost of the energy consumed, welds thus made compare favorably with respect to cost with those made in the usual way. In many cases an end-to-end welding apparatus may profitably be installed, thus dispensing with a smith and his assistant, and resulting in a notable economy. The apparatus for end-to-end welding is very simple, and can be easily used in connection with the bath.

A very important point in connection with welding is that the heating of the metal takes place in an atmosphere of gas where there are no impurities, so that the metal comes from a bath perfectly clean, and in a condition for perfect welding. Still another important fact may be mentioned. It is often necessary to weld a small piece to another much larger, and by usual methods a considerable part of the mass of the latter is required to be heated to the welding temperature, at a considerable cost in material and time. By the hydro-electrothermic process, as has already been explained, the part of the larger piece at which the weld is to be made need alone be heated, which permits the welding of a rod to the centre of a plate or of a bar in the middle of a disc, as for instance in the case of a tamper. Such welding is quickly and easily made.

The finished work, likewise, can be heated at a single point without any difficulty whatever. This is done by interposing a non-conductive material, such as porcelain, caoutchouc, etc., in such a way that the heat is absolutely localized at the desired spot. By this means an intense local action can be obtained in at any desired point of any object. This method also permits the employment of a relatively small amount of energy for the heating of a relatively large surface, for the "isolant" can be moved so as to expose successively all the points of a large surface to the influence of the electrical current. The heating will be necessarily less rapid, but the final result will be analogous to that which would be obtained if a larger but more costly installation were employed.

Those acquainted with the practical operations of metal working can easily conceive of the number of valuable applications of which the system is susceptible in this direction. On account of the great cleanness of the heated surface, and of the possibility of exactly regulating the effect of the heat by means of increasing or diminishing the E. M. F. of the circuit, very perfect welding can be obtained of iron or steel, ordinary steel on tool steel, etc., so that all the tools of the workshop can thus be forged and repaired under the best conditions. For this to be done the baths employed for heating iron or steel ought to be separate and slightly different in constitution.

Forging.—In many cases of forging by present methods it is necessary to either heat entirely or in great part a bar or piece in order to work a given portion of it, while, as remarked before, by the employment of the method here described, the part that should be worked can alone be submitted to the thermal action by the employment of an "isolant." Thus, one can heat the exact part of a bar which it is desired to bend, and so on. It is well to remember that finished work is not damaged by the operation.

Wire Drawing.—The annealing of wire which has been cold drawn is very perfectly performed continuously and in a rapid manner, by the hydro-electrothermic process. The wire to be treated is passed, first through a bath containing a cleaning solution, in which the wire is brought to the exact temperature required; it then goes into a washing bath, and then into an adjacent annealing bath, and finally through another washing bath. The regulation of the speed with which the wire is passed through the "heating" bath to conform to its diameter, the length exposed in the bath and the E. M. F. employed, which latter is also easily and absolutely controlled, enables most perfect results to be achieved in the annealing reservoir. Mineral oil or grease can be used, or an aqueous solution, according to the results which it is desired to obtain.

The Manufacture of Chains, etc.—Steel chains can be forged as perfectly as those of iron by this method, an electrolyte slightly different being employed in the bath.

Drop Forging.—Drop forging or stamping of small pieces is an industry to which the process here described is suitable. The operation is not only very rapid, but the quantity of metal employed can be much reduced, the finished pieces coming out perfectly shaped, with sharp edges and clean surfaces. Practical experiments made on the manufacture of fire-arms have indicated very great advantages, especially with respect to economy in material and reduction of work in finishing.

Tempering and Hardening of Steel.—The hydro-electrothermic process is admirably adapted for tempering, combining great rapidity and absolute certainty. The electrolyte employed in the bath is modified for tempering, a solution of carbonate of potash and glycerine being often substituted for water, the heating effect being thus more rapid, more delicate and under better control than when liquid solutions are employed. Small pieces of irregular form or irregular surfaces, such as files and other tools, can be perfectly manipulated without deformation, cracks or setting up strains. The piece, after having been brought to the desired temperature, remains, after the current has been interrupted, in the bath, where it is cooled gradually so that its temperature is identical in every part and molecular strains are not set up. Rapidity as well as certainty with which similar pieces can be identically and almost automatically treated characterizes this process.

The possibility of superficially hardening pieces of steel of any dimensions or form and to any desired depth, from a superficial crust to a considerable depth, without modifying the conditions of the interior, combined with the employment of the "isolant," by means of which a local part of the piece alone may be treated, constitutes a most important application of the system.

The numerous applications to hardening are evident and we may enumerate, as examples, the surface tempering of guns, of railway car and other axle journals, without affecting the nature of the steel composing the axle. They may be covered with a tempered surface of a fiftieth of an inch thickness or more, as desired, and that only and exactly on the length necessary. Other applications are to the local hardening of surfaces of any form after finishing without injuring the edges or altering the temper of the interior, such as the finished lock cases, the facings of a large number of tools, as picks, axes, hammers, wedges, etc. The bath ordinarily employed for this class of work is a solution of carbonate of potash in water, and the E. M. F. is relatively large, so that the operation is executed very rapidly.

As has already been said, there is produced in the baths under certain circumstances a remarkable action which is also of great practical utility. A piece of metal or conducting material can be heated in the bath without either electrodes being in real contact with it. For this the piece to be heated is suspended in the electrolyte and the negative pole approached very near to it. An arc or something of that nature starts from the pole to a piece to be treated, which then becomes surrounded by a luminous gaseous envelope and is rapidly brought to the required temperature over its entire surface. This is of a special value in the manufacture of small articles of metal which, after having been heated, are to be forged, rolled or stamped, and also in cases where a uniform temperature is required. Any part of the piece thus suspended can be isolated or protected as in preceding cases.

Cleaning Metallic Surfaces.—The electrochemical action which is produced in the bath at the negative electrodes is of a reducing nature, and all the oxides and other impurities, and even loosely adherent nodules of the metals themselves, are immediately removed from the electrode as soon as it is immersed in the bath by the action of the current. By this means plates or pieces of metal can be thoroughly cleaned. Among the industrial applications may be named the cleaning of tinned plates after having been plunged in the tin bath. With a little skill perfect cleaning of these surfaces can be done with an economy in respect to the tin employed and a diminution in the loss of plates. No decisive experiments have yet been performed in this direction, and it is probable that a slight modification in the electrolyte of the bath will be necessary. Taking only the figures that I have, I find that the number of amperes and consequently the energy necessary will be quite considerable for this operation, but its rapidity and certainty of a very appreciable economy in the amount of tin employed would justify its trial. The cleaning of the surfaces of pieces of metal after their coining as money is another field of application. Objects for electrical lamination can also be advantageously treated by this process after they have been immersed in special baths.

Brazing, Soldering, etc.—On account of the delicacy and the possibility of localizing momentarily a very intense heat by "isolation," as has been explained, the soldering of metals by means of copper and other solder is the subject of an important application, and in many cases, as for example, in bicycle work, the hydro-electrothermic process may be utilized in preference to those now employed, on account of its rapidity, cleanliness and the control which may be exercised over the operation during its entire duration. For brazing, etc., the glycerine bath can be employed and the metal of the positive electrode changed according to the metal to be worked. Sufficient experimental work has not yet been done in this direction, but what trials have been made show the perfect applicability of the process to all needs of this nature. The atmosphere of reducing hydrogen plays an important role in such operations, as will be easily understood, and the question of fusion, etc., is consequently much simplified.

Electrochemical Metallurgy.—The application of the process to the working of iron and steel only has been dwelt upon almost exclusively for the reason that they alone open up an immense field for its utilization. It is apparent, however, that any metal can be worked by this process and treated, melted or heated as is desired. Necessarily, the electrolytic character, and even the composition, etc., of the bath, requires in each case some corresponding modification, but the *modus operandi* and the general principles of the system remain invariable. Moreover, minerals and inert refractory substances can be easily melted and results at present impossible obtained.

A New Definition of Magnetism.

In the course of a recent lecture, Prof. Silvanus P. Thompson said that though an electric current could produce magnetic effects, and electricity applied to a coil of wire made a magnet, the relation between magnetism and electricity was a mystery which had yet to be solved. Referring to this, the London *Electrical Engineer* says: "We wonder if Prof. Thompson has met the author of a work on 'Magnetism: Its Potency and Action, with Suggestions for a New Cosmography and a New Celestial Geography,' who gives the following definition of magnetism: 'Magnetism is the connecting link between mind and matter, or rather the medium by and through which the Divine energy is imparted to all matter, and the primary exhibition of this energy is an exercise of God's will. The Deity is the omnipotent magnet. Electricity is condensed magnetism, and electricity, light, heat, gravity, sound, capillary attraction, repulsion, attraction, disruption, and explosion are modifications of magnetism, and are influenced by it!'"

A Suggestion for a Day Load in Alternating-Current Lighting Stations.

There are many existing lighting stations to-day where the lighting load is met by two or three simple alternators. Very often it is the case that they are identical in speed, and they are always identical in frequency. Occasionally they are driven from two fly-wheels of the same high-speed engine. Lighting stations which are so fortunate as to possess such an arrangement have at their command a method of carrying a power load at a very slight expense. By rigidly coupling the two shafts of two similar alternators together so that their armatures bear the proper relation to each other, two-phased currents—that is, two currents of which one has its maximum value when the other is at zero—may be obtained for the operation of two-phased motors, which type of motor, unlike the simple, alternating type, can be started with or without load in the same manner as a continuous-current motor.

The mutual working of these currents can be more accurately regulated than can the currents of a regular two-phased machine. In the case of a two-phased machine should one of the circuits have a heavier load than the other it will require a stronger field to maintain its voltage, which will cause the coils of the other circuit to deliver a voltage that is too high. In the case of two single-phased machines connected in this manner, the difficulty is in nowise present, as each machine will operate with its load precisely as if the other machine did not exist. No line wires installed need be taken down or any change made in the type of transformers. Wherever a motor is to be operated it is only necessary to bring to the place lines from both alternators and connect with two transformers. The motor will operate at an efficiency equal to if not superior to the best direct-current motor and require considerably less attention. Power is now frequently transmitted for city purposes at 500 volts, but the saving in copper in transmitting at 1100 or 2200 volts, as the case may be, is very considerable, being inversely as the square of the voltage. It is quite probable that the manufacturers will frown upon this method, and some perhaps go so far as to say that such operation is impossible, but, nevertheless, those who care to try it will find it entirely practicable. It is surprising to the writer that it has not been frequently practiced heretofore. Stations using alternating-current generators and proposing to increase their system will do well to consider duplicating the single-phase alternator they already possess, as by this means the plant capacity will be increased the amount of that unit *for both light and power*, and the installation of the combination indicated may even be worthy of consideration in new stations. Its merit lies in the fact that absolutely no material is relegated to the scrap heap by its introduction. It may be added, that once having two-phased currents, three-phased currents can be very economically produced by means of special transformers.

The Doctors and the Electric Light.

To the Editor of The Electrical World:

SIR—An article appeared in your issue of Nov. 23, entitled, "The Doctors and the Electric Light," with the comments of the London *Electrician*, which may voice the opinion of many another newspaper and electrical engineer. Yet, without desiring to be sentimental, permit me to call your attention to facts which cause me to say in reply to this article that those doctors may not be entirely wrong.

Engineers have to reject, of course, the two extremes of unprotected lights for all purposes or places and universally shaded or protected light sources. We want and need as much light as we can get, and as efficiently as possible. This would call for an unobstructed passage for the arc lamp rays, and this method is all right for general lighting, but at electric or cable railway crossings they certainly are not only a nuisance, but are dangerous. A man driving a team is unable to look into the darkness beyond the arc-light, because he is blinded by the latter, and this may account, to a considerable extent, for the many accidents on railway crossings in this country. But this is a digression.

Returning to the matter of incandescent lamp illumination: It may be generally supposed that the soft yellow light could not hurt or be injurious, and yet there *are* faults, not with the lamp or its light, but with its improper use, which in some cases is so annoying that the word "savage," as expressing the barbarous method of application, is not thought to be too strong. An example of such lighting is the Auditorium Theatre in Chicago. The colossal arches, bridging from one side to the other, are profusely ornamented and gilded, and in this glitter are located the incandescent lamps upon which the upper part of the house, to a great extent, depends for its illumination. In the daytime the appearance is ornamental and pleasing; in the evening, however, this arrangement annoys the spectator, as the lamps are always in the line of vision, particularly from the balcony and galleries, where more than three fourths of the music-lovers are to be found. The nuisance was such that the newspapers took up the complaint, with the result that the management has caused the lamps to be reduced in brilliancy during the performance, and latterly have used frosted lamps, but the nuisance is there still.

The result is that many a person is afflicted with a violent sick headache the next day. A number of such cases have come to my personal knowledge. The reason that I dwell to such an extent on this place is that architects, as well as engineers, may be impressed with the fact that not only the effect by day should be satisfactory, but also at night. This is an example where money was no consideration to provide all possible means to obtain the best results; it is well known that the station machinery and devices are excellent, but in spite of this the lighting of the theatre is an utter failure. A person's eyes should not meet the *source* of light, whether it consist of a large number of incandescent lamps or of an arc lamp. One admirable method of preventing this was shown at the World's Fair by the unpretentious but capable engineer of the Brush Company, Mr. E. R. Prentiss, who placed the incandescent lamps in a deep, projecting cornice a distance from the white ceiling, onto which light was reflected and from which it was distributed in a very effective way, the source itself being invisible.

The statements of the doctors are overdrawn, and the trouble will never be as widespread as they claim, but there is some truth in their statements which deserves to be carefully considered. To the writer, such lighting as that above described is on the level, in regard to beauty, with nose-rings, high-heeled shoes and chignons, which may be ornamental according to fashion, but produce injurious effects as a consequent penalty of such *so-called* ornamentation.

CHICAGO, Ill., Nov. 25, 1895. LUDWIG GUTMANN.

Motor Rheostats.

To the Editor of The Electrical World:

SIR—It seems to me time that some attention should be called to misleading and injurious statements often made with respect to rheostats. I have in mind especially the distinction between motor speed-regulating rheostats and motor-starting rheostats.

There are very few people who are acquainted fully with the very great difference necessarily existing between rheostats of these two types. A motor speed-regulating rheostat must have capacity in each step of the rheostat sufficient to carry for an indefinite period continuously the full load-current of the motor.

If the motor be operated at an extremely slow speed under conditions of full torque, such as, for instance, will be the case in the operation of a printing press at slow speed, the current through the motor armature and rheostat in the case of a shunt machine will be just as large as when the motor is running at full speed, but while the motor is running at slow speed almost the entire voltage of the circuit is dropped in the rheostat; if, for example, on a 500-volt circuit the motor was running at one tenth of its full speed, the rheostat must have capacity to absorb the full rated current of the motor and have upon its terminals nine tenths of the E. M. F. of the supply circuit; that is to say, the rheostat must absorb and dissipate continuously without destructive heating nine tenths of the full rated capacity of the motor in watts.

A motor-starting rheostat does not need to have more than one fifth of the radiating surface that is required in the case of the regulator, this being due to the fact that, in the case of regulators which are kept in circuit for long periods of time, all of the energy must be dissipated by radiation and convection by air currents; whereas, in the starting rheostat, which is only in use temporarily, a very large amount of heat energy is taken up by a material having a high specific capacity for heat, and whose surface temperature is not therefore affected greatly, but which will continue to radiate slowly during the time when the rheostat is out of circuit or only partially loaded.

Prospective purchasers of rheostats who naturally do not appreciate these points fully are very much misled by descriptions of rheostats which are claimed to be speed-regulating rheostats, and which, with the dimensions published in connection with them, could not possibly operate as such. For example, a certain motor speed-regulating rheostat, is described as having a length of 20 inches, a width of 15 inches and a depth of 21 inches. This rheostat would go inside of a cubical body having a surface of 2000

square inches. The full current load for a 500-volt motor, 50 hp, is given as 100 amperes. In operating an ordinary motor at a speed of about one tenth of its full speed, the watts which this rheostat must continuously dissipate would be about 40,000; that is, the surface of the cube represented by the dimensions of the rheostat must continuously dissipate energy at the rate of 20 watts per square inch. Such a rate of dissipation would make the entire apparatus reach a temperature considerably above bright red heat.

I find that this subject is one that is not carefully considered by purchasers, and as the type, design and material of the rheostat are in no way involved in the above statement, it furnishes an illustration for the benefit of all interested to the distinction that should be made between a starting rheostat for intermittent use and a regulating rheostat for continuous use.

As will be evident from the above, a regulating rheostat can be readily tested by placing it directly across the line with all resistance in circuit, and allow it thus to receive the full rated current. A rheostat which will stand this test for two or three hours can be properly called a regulating rheostat, and if it be really only a starting rheostat it is pretty certain to start something during that time.

Hoboken, N. J. H. Ward Leonard.

The Standard Telephone Company at Richmond, Va.

To the Editor of The Electrical World:

Sir—As the statement of the Standard in The Electrical World of Nov. 23, that Judge Christian "disclaimed all anti-Standard allegations," is absolutely false, I trust you will allow space for the facts.

Inclosed clipping from the Richmond *Dispatch* will show that Judge Christian repeated and emphasized the charges.

I have personally made myself responsible for the charges after investigating them, and can be imprisoned for criminal libel if I cannot prove them.

The Standard people threatened me with legal action over three weeks ago, but on my replying that I would be glad to have an early opportunity to prove them in court they dropped the matter.

The charges are, briefly: 1st. That the Standard Company issued a confidential circular to their agents suggesting the bribery of Councils. This has been admitted by men now directors in Standard branch companies, and by others formerly directors, who resigned because the truth of Standard claims could not be proven to their satisfaction. 2d. That the Standard Company exhibited a telephone in Richmond, claiming it was made under their patents, but which was really a Bell long-distance 'phone, or a rank infringement on the Watson & Rooseveldt patents. That they absolutely refused to permit any expert examination, even when Mr. Maxwell offered, by advertisements in the Richmond papers and elsewhere, to pay $100 reward if he could not prove above, and a further reward of $10 for the number of each patent they owned covering any part of the telephone exhibited. These offers I am ready to-day to back up by the deposit of the cash in any Richmond bank. And I will increase these rewards to any reasonable amount, though the Standard claim to own forty-six patents, and the offer subjects them to no expense, if they should be insufficient.

In spite of all the above, the Standard Company, in an advertisement in the New York *World*, had the effrontery to claim that their telephone had been investigated and approved by a committee of experts in Richmond, but their audacity in making equally false statements in your columns is even more amazing.

The Standard Company months ago issued a circular which they have not yet been compelled to repudiate, part of which reads: "The Standard Telephone Company owns a telephone transmitter which has the broad claim allowed in its patents—of electric power for conveying speech on a wire. This is the best and broadest claim ever allowed, and this is the only transmitter which has this claim allowed by the patent office."

This, with the other matter in this circular, has been enough to condemn the company issuing it with every telephone expert I have ever seen. I will give one hundred dollars for the number of any patent owned by the Standard Company containing the above claim.

Baltimore, Md. W. J. Atkinson.

[The following is a portion of the remarks of Judge Christian as given in the clipping referred to, which contains a report of proceedings before the Common Council.—Ed.]

"He next took up the charges of the latter company (the Home Company), and maintained that they had not, and never could be, refuted, and that he was prepared to prove that the company was grossly unworthy, and had not a single telephone exchange in any part of the country. The company had, he asserted, collected from different people $300,000, and though they had promised time and again to put up an exchange, they had never done so. 'We charge,' he said, 'that this Standard Telephone Company has no patents of its own,' and, proceeding, the speaker quoted from The Electrical World to the effect that the statement of the Standard Company owning certain patents would come as a surprise to the friends of that company.

"The Standard Company had no 'phone, and had no switchboard with which it could supply 'phones to this city. Mr. Barnes, he said, had admitted that the circular announcing that the Standard Company had money to grease the wheels of the City Council with, had emanated from his office, but without his knowledge."

When his attention was called to the foregoing, Mr. Thurlow Weed Barnes, president of the Standard Telephone Company, said the matter had been sufficiently ventilated, and that he thought the public was "tired of windy stuff about the Standard." "In regard to Maxwell, Atkinson & Co.," he added, "they are disposed of by Francis Ralston Welsh, in the last issue of *City and State*, published in Philadelphia."

The following is an extract from the article referred to:

"The Home Company, of Richmond, was endeavoring to obtain an exclusive franchise to operate in that city, using the Mason Company's telephones. The Richmond Standard Telephone Company had also applied for a franchise there. The telephone committee of the Chamber of Commerce indorsed the Standard's 'phones, and the city engineer and a special committee of councils reported favorably to the Standard Company and against the Home. Finding they could not win by fair means, Messrs. Atkinson and Maxwell launched out in a tirade of abuse and misrepresentation so reckless that the attorneys of the Home Company, Judge George L. Christian and Mr. Wise, both publicly and privately, disavowed all responsibility of themselves and their company for these attacks.

"Mr. Maxwell's circular offering rewards was a mere bluff. The rewards were too small to pay even the expenses of any one trying to earn them. Mr. Atkinson says an aggregate of $460 in rewards, could have been gotten by giving the numbers of the Standard's patents. This is false. The reward offered was for the number of any patent covering the telephone exhibited, and $20 only could have been earned and probably nothing collected. Mr. Atkinson's profession of belief that the directors of the Standard Company are deceived is ingenious. For him to have attacked the characters of such men would have merely discredited him without injuring them. But this assumption is a very shallow fiction. That business men of the ability and versatility of those connected with the Standard should all be wrong and only Mr. Atkinson and a few others (all by some strange coincidence connected with rival companies), should be right is too absurd to merit serious consideration."

Postal Telephony.

To the Editor of The Electrical World:

Sir—Referring to articles which are going the rounds of the newspapers in which the writer's name is connected with the government plan to take up the question of postal telephony, I beg to advise you that in some cases insinuations have been cast upon the low rate per message calculated. Of course, time will bear out the writer's position, he is confident. However, in order to verify to some extent his position it may be in place to state that in a number of European places the total toll-line telephone rate exacted for five minutes' conversation is five cents. This was adopted by a recent rule in Berlin within a 15 or 50 mile radius, I have forgotten which. The writer is confident that postal telephony will, within the period of his activity in public work, be as economical for messages as the postal service of to-day.

J. E. Keelyn.

The Weston Standard Cell.

The Reichsanstalt, that well-known government institution in Germany, whose purpose is to examine and test the finer instruments of measurement, has several times reported very favorably on the Weston cadmium cell. In a recent report of that institution an important future is predicted for it, a very careful examination having shown that it is in no respect inferior to the Clark, while in other respects it is greatly superior. It was found, among other things, that with 1.1 per cent. of the cadmium the voltage was very nearly unity.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Synchronous and Non-synchronous Motors.—"L'Eclairage Elec.," Nov. 2, contains an article by Mr. Boucherot, in which he compares the rela tive advantages of these two forms of motors. He considers that in the recent discussion the conclusions were given too hastily in favor of the synchronous motors; concerning the efficiency, he claims that it is certain and admitted by the best constructors that the non-synchronous motor has a higher efficiency than the synchronous, but the question is of importance only from a theoretical standpoint as the difference between the two is only 2 or 3 per cent.; it is incorrect to suppose that it is easy to increase the efficiency and the specific output of a non-synchronous motor in transforming it into a synchronous one; the non-synchronous motor can in a certain sense be considered as a synchronous one in which the ampere-turns for excitation are supplied by the original source and the ampere-turns to compensate for the reaction are supplied by the part in which the currents are induced, and in that case there is an advantage for the non-synchronous form in that the latter vary automatically with the load. The only way to transform a non-synchronous into a synchronous motor is to provide for a considerable increase in the air gap, which involves a considerable increase in the ampere-turns for excitation. Numerical results are given. Regarding the specific output he claims that it is evident, for the same reason, that it will be less in the synchronous motor because it is necessary to use much more iron and copper than in the non-synchronous form. A synchronous motor ought to have a small reaction in order to operate well. Regarding starting, it is claimed that a synchronous motor will start as well as a non-synchronous. This he questions. Under the same conditions concerning the iron of the field and the number of windings of the armature, a synchronous motor ought to have a much larger air gap than a non-synchronous. He considers that it is impossible for the synchronous motor to be started as well as the non-synchronous. To get these results one must sacrifice the good running qualities of the synchronous motor while it is being synchronized, and he believes it impossible to fill both requirements. Regarding the difference in phase between the current and the voltage, he states that the non-synchronous motor is inferior to the synchronous one; there is no phase shifting in the latter, while in the former there is always a difference of at least 30 degrees; it is not right to say that non-synchronous motors on distribution circuits limit very greatly the power of the generators and involve a lowering of the voltage in the distribution; if this does happen he believes that the generators are very poor; and an alternator ought to be able to deliver its maximum current at full voltage even at a phase difference of 90 degrees; with a well-constructed alternator the avoidance of the phase shifting involves only 15 per cent. in the power if it is used exclusively for motors. A synchronous motor is also more complicated and requires greater care; for distributing power in factories he believes no one would consider the use of synchronous motors.

Diphase Motor.—A brief, illustrated description, with dimensions and details, of a 4.5-kw motor constructed by Brown, Boveri & Co., in Switzerland, is given in "L'Ind. Elec.," Nov. 10.

Raising the Voltage of Transformers.—Mr. Miller, in the Lond. "Elec. Rev.," Nov. 15, calls attention to a property of transformers which he believes is not widely known, namely, that the secondary voltage may be added to or subtracted from the primary. "It is the current at the primary terminals, that is, the street current, and not the current through the primary windings, that is added to the secondary. The reason that this is possible is owing to the impedance of the primary winding throwing the current through it out of phase with the street current, and the current through the secondary being in opposite phase to the primary, the former is in phase with the street. If a 220-volt, 100-cp lamp be burned from the transformer in question, it need only be large enough for a 50-cp lamp. The current registered by the consumer's meter will be double the current that goes through the lamp." In a diagram he shows a 110-volt current connected to the primary winding of a transformer whose primary and secondary have an equal number of turns, and a 220-volt lamp connected between one end of the primary and one end of the secondary, the other end of the secondary being connected to the other end of the primary.

Control of Transformer Losses.—Mr. Whitcher's long article is continued in the Lond. "Elec. Rev.," Nov. 15. He describes his "changing-phase" system, in which the sides of the primary three-wire feeders are charged with alternating voltages equal and similar, but differing in phase by an amount which is adjustable, so that any voltage from zero to a maximum may be obtained across the outer conductors, while that on each side remains constant. The induction between the outer mains, the power and the iron losses, he states, are capable of graduated control by means of a graduated adjustment of the phase difference and therefore they can be kept proportional to the useful load within limits, whereby the converting plant may be worked at a maximum efficiency for any value of the load.

Method of Detecting Weak Dynamo Fields.—Mr. Speed, in the "Rose Technic" for November, describes the following method which he has used in a number of cases, and which never failed: Measure the resistance of each coil by means of a Weston voltmeter and ammeter, using successively different currents, beginning with a small current and increasing up to a large one. If the insulation of the field-coils is perfect, and the instrument reliable, the resistance will be constant or rise slightly, due to the warming of the field. If, however, there is a "carbonized and oily field," its resistance will be constant for weaker currents; but as the current is increased, the resistance will suddenly drop, sometimes as much as 20 per cent. A numerical illustration is given.

Simple Transformer Diagram.—In an article in the "Sibley Jour." for November, Dr. Bedell describes the simple transformer diagram and its application. It does not admit of being abstracted. In a second paper, to be published, the same relations will be deduced analytically.

Transformer Efficiencies.—In reviewing a recent work by Mr. Feldmann, "Elec. Eng'ing" for November reprints a table from it, giving the monthly efficiencies, and compares it with a similar table given by Prof. Jackson.

LIGHTS AND LIGHTING.

Street Lighting by Arc Lamps.—Prof. Blondel's paper (see Digest last week) is concluded in the Lond. "Elec.," Nov. 15. All the arrangements which he has discussed have a common fault, namely, the great distances between the lamps, which make the distribution of light a very unequal one; this may be reduced by using less powerful lamps, and he thinks this subject ought to receive more attention; in Munich, for instance, there are in use 48 lamps of 5 amperes; he believes that the expense per lamp, aside from the consumption of power and carbons, is only a small fraction of the whole, the energy consumed being the most important factor in making up the annual cost; this he explains further, and concludes that the variation in the annual price per lamp does not differ very much from the law of proportionality with the current; by substituting lamps of 5 amperes for those of 10, he finds that for equal cost the total luminous flux is reduced in the ratio of 0.73, but the distance between the lamps would be reduced in the ratio of 0.625; it is especially bad practice to put large arc lamps in streets 27 to 33 feet in width at distances of 133 to 200 feet; in such cases smaller arcs should be used; large arcs may be better if the cost of the energy is small and the cost of carbons and labor great, as, for instance, in a railway station. He discusses at some length the physiological principles, and more particularly the property which the pupil of the eye possesses in contracting and dilating, to regulate the quantity of light admitted into the eye; the diameter of the pupil of a man's eye may vary from 10 to 2.5 mm., from which it follows that the quantity of light received by the retina may vary in ratio of 1 to 16 and the object may therefore appear 1 to 16 times as luminous for an equal photometric lighting, according to the opening of the pupil; according as a source has small or great brilliancy, one can, with the same quantity of light, realize a good or a bad useful effect; mere photometric measurements of illuminations may therefore be completely illusory; an absolute increase of light does not always give rise to a relative increase of public satisfaction; the effect of contrast is the more annoying, the more powerful the lamps and the farther they are apart; the candle-power should therefore be proportioned so that the space between the lights may be about double the width of the streets. Two things are necessary for good public lighting: First, to reduce the photometer illumination, losing as little flux as possible, and, second, to enable the eye to take in as much as possible by having the intrinsic brilliancy small; by knowing how to calculate the effects beforehand the expense of lighting might be considerably reduced and the same apparent results obtained. In his conclusions he states that the conditions generally imposed in contracts for lighting are insufficient, and they should be complimented by a consideration of the "superabundant illumination"; he suggests imposing the following conditions: A mean illumination of all the useful illumi-

nated surfaces, a minimum horizontal illumination of the roadway, a minimum vertical illumination at a certain height which may be taken as that of the roadway, a mean superabundant horizontal illumination in a circle, an excellent division of the light, that is low apparent brilliancy and an intensity proportioned to the width of the street. For the mean illumination he suggests 1.5 lux and for main streets 2 lux; he gives a table of values by which one may be guided, but they apply to lights in Berlin and Paris. He criticises unfavorably the methods by which lighting is charged for; to charge for the current in the case of arc lighting leads to a bad utilization of the energy, and a use of carbons of larger diameter, which reduces the cost of renewals, and which lowers in an enormous proportion the luminous effects; the only logical method is a contract for a useful luminous flux; that is, the quantity of light emitted below the horizon measured in "lumen-hours" just as the energy is calculated in watt-hours; the objections to this may be avoided by providing in the contract for a certain number of hemispherical lumen-hours per lamps, the type of lamp being approved by being tested by an authority whose certificate would be accepted; among these measurements are the voltage or current and the diameter of the carbons, which latter should always be indicated in the contracts.

Incandescent Lamp Efficiencies.—Mr. Robertson, in the Lond. "Elec. Rev.," Nov. 15, draws some comparisons between the Robertson lamp and those of other makers, from the recent tests of Mr. Paisley, which were noticed in the Digest, Nov. 23; the tables for these tests are published in full in the same issue (see also Digest, Oct. 12). He believes the three points in their order of importance for the best lamps are: "1. That which, during its life, has on an average the least percentage increase from its original watts per candle-power. 2. That which, during its life, has on an average the least falling off from its original candle-power. 3. That which, with due regard to the monetary economics effected by 1 and 2, has the longest life, *i. e.*, that which has the most economic life."

Small Arc Lights.—Dr. Lux, in the "Zeit. f. Beleucht.," Nov. 15, under the heading of "A New Phase in the Development of the Lighting Industry," points out the superiority of the arc lamp, showing that the efficiency is one and one half times as great as that of the incandescent gas light, when the gas is used in a gas engine, and with large stations even three times as great. The objections to it are only that the quantity of light is very great, but this could be overcome by small arc lamps, for which he prophesies a promising future. He mentions a small lamp made by Niewerth in which the difficulties are claimed to have been overcome, as it regulates with certainty down to as low as 0.5 amperes and will burn for hours without flickering. A detailed description is promised.

The Arc Light.—Prof. Thompson's first lecture is concluded and the second begun in the Lond. "Elec. Rev.," Nov. 15. He discusses the researches of Prof. Ayrton, arc furnaces and the optics of the arc, under which latter he considers the distribution of the light and its dependence on the crater and peak.

Street Lighting by Arc Lamps.—The table mentioned in the Digest last week in the abstracts of Prof. Blondel's article, giving certain data for a number of different cities, is reprinted in the "Elec. Eng.," Nov. 27.

Electricity for Gas Lighting.—The illustration of the device described in the Digest last week under this heading is reprinted in the "Elec. Eng.," Nov. 27.

POWER AND HEAT.

Electric Power in a Factory.—A description of some length, by Mr. Snell, accompanied by illustrations, curves and tables of data, of the power in Siemen's works, is published in the Lond. "Elec.," Nov. 15. The plant was designed to replace 18 isolated steam engines and it generates 1030 electrical hp at the switchboard. It includes 85 motors from 1-6 up to 100 brake hp; several of the tools are illustrated, as also a method of driving by means of friction pulleys, in which the motor pulley is made of pressed paper, and there are two pulleys, a large and a small one, rolling against it on opposite sides, but connected together by a belt which produces the pressure between the driver and the driven pulleys and prevents the side thrust on the motor shaft. Results of carefully made tests are given, showing the steam consumption; the annual load factor is 28.5 per cent. The tests are those published in a paper by Mr. Siemens about a year ago. He considers that these tests prove that power distributed from an electric central power station costs less than when delivered from independent steam engines, but whether it will pay to convert an existing steam plant into an electric plant depends upon local situations, and requires a careful weighing of all the factors.

Electric Power in a Copper Mine.—A description of the application of electricity at the Osarusawa mine is given in the "Elec. Friend" (Japan), for September; it is used for hoisting 1680 feet, the voltage being 500; the pump elevates 190 feet; wood is used as fuel, but water power will probably be substituted.

Electric Furnaces.—A long abstract of a paper by Mr. Moissan describing his researches, is published in the "Proc. of the Phys. Soc.," for November.

Shoe Blacking Machine.—An automatic machine is described and illustrated in the "West. Elec.," Nov. 30.

Drill.—The Siemens & Halske mining drill mentioned in the Digest Nov. 2, is illustrated and described briefly in the "Elec. Eng.," Nov. 27.

TRACTION.

Electric Railway in Japan.—According to the "Elec. Friend" (Japan), for September, rules were officially issued in Kyoto regarding the electric railways, among which is one stating that in streets where traffic is dense, or at corners, bridges or dangerous places, a flagman must walk 30 feet in front of the car; the speed of the car cannot exceed six miles per hour. This city has no sidewalks and the streets are narrow; 20 to 25 hp motor cars are running on nine miles of road, using the single trolley, the energy being obtained from water power.

Electric Car Tests.—Prof. Hermann Hering's serial is concluded in the "Elec. Ry. Gaz.," Nov. 23. He gives briefly some interesting deductions from the tests. He shows the cost of making a stop, taking as an illustration a case where the cars on a double-track road are compelled by law to stop before an engine house, on which there are 30 cars making 15 round trips and finds that the cost for energy alone is 76 cents per day, or $278 per year; he finds that the kinetic energy of a car with a load of 10 passengers at 10 miles an hour is 21.6 watt-hours; also that the difference between making a stop and not making it is about 85 watt-hours, from which he concludes that the efficiency of starting is about 25 per cent. The increase of energy required per passenger per mile varies from 0.5 to 4.4 watt-hours, according to the load and number of stops; the average for a 20-stop, 20-passenger trip is 1.4 watt-hours per passenger mile, or 100 watt-hours per 100 pounds per mile, but it varies greatly. The paying load on the Pikesville road varies from 2 to 36 per cent., the average for the day being 8 per cent.; on city roads it averages from 10 to 15 per cent.; about half the total number of passengers on a trip is a fair estimate of the equivalent continuous load; by reducing the weight of the car the percentage of paying load would be increased, especially when the travel is light; 1000 pounds less weight amounts to a saving of 10 watt-hours per car mile, or $87.60 per year for a 15-car road; the passengers thus increase the demand on the power-station only a small per cent.; a power-station test showed a practically horizontal load curve with scarcely any increase during the hours of heaviest travel, the cars being run on a uniform schedule; he concludes that the number of cars should be adapted to the paying load.

Electric Railway Signal for Crossings.—The Skeen system is described and illustrated in the "Elec. Eng.," Nov. 27; it is intended to provide signals at crossings of two electric lines; both day and night signals are provided for; they are operated by the cars themselves. By means of an insulated section of trolley wire some distance in advance of the crossing the signal mechanism also cuts off the current from that section as a safeguard in case the signal was not noticed.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Paris.—A paper by Mr. Laffargue on "The Present State of the Distribution of Electrical Energy in Paris," is reprinted in "L'Ind. Elec.," Nov. 10. He considers that this industry is not sufficiently developed in that city, there being a total of only 51,500 hp. The charge is considered to be too high, it being 16 to 18 cts. per kw-hour. The commercial side of the question is discussed in a paper by Mr. Meyer.

Kyoto.—According to the "Elec. Friend" (Japan) for September this station, which is driven by water power, is equipped entirely with American machinery, including three Thomson-Houston alternators for lighting, two Stanley two-phase generators and two Edison machines for power, two multipolar railway generators of the General Electric Company, and 13 Pelton water wheels of 120 hp with a head of 130 feet.

Alternating Current Machinery.—In the continuation of Dr. Preller's article in Lond. "Engineering," Nov. 15, describing the installation at Baden, a number of good illustrations of the apparatus are given.

Central Station Economics.—An article under this heading, by Messrs. Abbott and Dommerque, is begun in "Elec. Eng'ing" for November. The present portion deals almost exclusively with the features of a station which belongs under the heading of mechanical engineering.

WIRES, WIRING AND CONDUITS.

Calculation of Leads.—"L'Ind. Elec.," Nov. 10, contains a mathematical article by Mr. Rodet in which he deduces a number of comparatively simple formulas. He considers, first, conical conductors, that is, those which diminish in cross-section toward the farther ends, as applied to a case in which current is taken off uniformly along the whole length; he develops the formulas and shows that the conductor ought to have the form of a truncated paraboloid of revolution and not that of a cone; in considering cylindrical conductors under the same circumstances, he shows that the loss of voltage at the end is the same as that for a conical wire of the same volume and length. He then considers leads formed of a series of successive truncated cones, and shows that the condition required so that the loss of voltage at the end is a minimum, for a given volume of metal, is that the sections of the various portions should be proportional to the square root of the currents in them; this is independent of the length of the cones. He shows that the loss at the end of such a composite conductor is about 11 per cent. less than the corresponding

loss in a conical or cylindrical lead of the same length and volume; or if the loss is the same it means a saving of 11 per cent. in weight of the metal. He gives formulas for the cross-sections at the beginning, and for the loss of power; regarding the latter he states that when the total loss of voltage at the end is the same in the three cases, the loss of power will be least in the conical lead; if the composite form has the same volume as the conical, the loss of voltage in the former will be about eleven per cent. less, but the loss of power will be greater than that in the conical lead in the ratio of 32 to 30.

ELECTRO-PHYSICS AND MAGNETISM.

Cathodic Luminescence.—A paper by Messrs. Widemann and Schmidt from the "Wied. Ann.," No. 10, is noticed briefly in the Lond. "Elec.," Nov. 12. The most striking colors observed are the red of mixed magnesium and magnesia sulphates, the yellow of cadmium sulphate, the green of calcium fluoride and magnesia, the dark green of quinine bisulphate, the violet of lead sulphate and the brilliant white of zinc sulphate or sulphide, and calcium iodide. Luminescence ranges over the temperatures from — 80 degrees C to + 500 degrees C. The intensity of the glow and the duration of the after-glow are greatest at the lowest temperature; sulphates of iron, nickel and copper, even in small quantities, extinguish the luminescence.

Influence of Pressure on the Conductivity of Solutions.—An article by Mr. Tammann, in the "Zeit. Phys. Chem.," 17, p. 725, is abstracted briefly in the "Proc. of the Phys. Soc.," for November. He shows that pressure reduces the conductivity by reducing the volume, diminishing the viscosity, and increasing the dissociation constant; 500 atmospheres increased the conductivity 4.5 per cent.

Double Refraction of Electric Rays.—An article from the "Wied. Ann.," No. 9, by Mr. Lebedew, is translated in the Lond. "Elec.," Nov. 15.

Magnetic Field in a Plane Circuit.—The Lond. "Elec.," Nov. 15, contains an article by Mr. Price, in which he describes how a certain integral may be measured for any point, by an apparatus similar to Amsler's planimeter. This integral is the one occurring in a recent discussion by Mr. Everett for calculating the magnetic force at any point in the plane of a plane circuit carrying a current; the instrument is illustrated. Mr. Everett, in the same issue, considers that Mr. Russell, in his paper (see Digest, last week), unnecessarily complicates his (Everett's) formula.

A Physical Society paper, by Mr. Everett, on "The Magnetic Field of Any Cylindrical Coil or Plane Circuit," is noticed briefly in the London journals, Nov. 15. The general results are of a simple form, and admit of easy approximate calculation. In the discussion, Mr. Trotter stated that the results might be applied to the solution of a problem of illumination, as, for instance, the illumination of a room by a circle of lamps.

Magnetic State of the Planets.—A paper from the German by Mr. Leyst is abstracted briefly in the "Proc. of the Phys. Soc." for November. He gives the results of a number of carefully made measurements, from which he concludes that the planets are so highly magnetized that they are capable of affecting the magnetism of the earth to an extent which is recognizable with the magnetographs now in use.

Magnetization of Iron.—"L'Eclairage Elec.," Nov. 2, contains an abstract, with the diagram, of the article by Prof. Zickler, which was abstracted in the Digest Nov., 2.

Sewage Purification.—An abstract from a recent paper by Prof. Langley is reprinted in "El'ty," Nov. 20. After describing the Wolf and Hermite processes, he gives the results of some experiments which he made, from which it appears that 6.37 pounds of chlorine can be generated per hour with one electrical hp; this quantity will purify over 14,000 gallons of sewage per day of 10 hours; the cost of the process will be little more than the cost of the electrical energy, that of pumping the sea water and a small amount for wages; this he estimates at 25 cents for 1400 gallons when carried out on a 500-hp scale; taking the wholesale price of bleaching powder, the cost to do the same work with it will be about 20 times as great; even when the cost of the salt is added, as in inland towns, the expense, he believes, will still be much below that of bleaching powder.

Chlorine and Soda.—The "Eng. & Min. Jour.," Nov. 23, states that a large company has been formed in England to operate the Castner and Kellner processes; the plant is ultimately to be one of 4000 hp and its total cost is estimated at $650,000; it is calculated to produce 18.5 tons of pure caustic soda and 40 tons of bleaching powder daily by a continuous process; it is estimated that with the more favorable advantages at this new plant pure caustic soda can be reduced at $21.25 per ton including $1.50 for drumming and bleaching powder at $15 per ton, including $4.75 or barreling.

Magnetic Separation of Free Gold.—In the "Jour. of Elec." for October, eut. Stuart Smith suggests an apparatus similar to the magnetic separator, for separating free gold from black sand. The gold exists in the form of thin flakes; if the sand containing the gold be passed in a thin stream in front of a magnet excited by an alternating current of high frequency, or be blown against the poles by a gentle air blast, it is thought that the alternating field will generate currents of considerable magnitude in the gold flakes and that the reaction between these and the field will cause it to be separated from the sand.

ELECTRO-CHEMISTRY AND BATTERIES.

Preventing Evaporation in Leclanche Batteries.—Mr. Herkt, in the "Elek. Zeit.," Nov. 14, gives the results of some tests to find how the introduction of glycerine, as suggested by Mr. Dieterich (see Digest, Nov. 16) to prevent evaporation and crystallization, affects the internal resistance; he tested a cell with and without the glycerine as also with an amalgamated zinc electrode; the E. M. F., with and without the glycerine, was the same, but the internal resistance was increased about 6 per cent., which, with small currents such as used in microphones is of little importance; after short-circuiting, the recovery was best in the cell with glycerine and amalgamated zinc, while it was slowest with a pure solution and an unamalgamated zinc, the E. M. F., with amalgamated zinc, was 2.4 per cent. less, and the internal resistance was appreciably less.

Amalgams of Iron.—A paper by Mr. Zamboni, from the Italian, is abstracted briefly in the "Proc. of the Phys. Soc." for November. He prepared amalgams of iron by the electrolysis of an aqueous solution of ammonium ferrous sulphate, using an iron plate for the anode, and a surface of mercury as the cathode. The amalgam obtained is strongly magnetic, more so than the black powder formed by its decomposition; if the magnetizing or demagnetizing force is slowly changed, it is found that the change in the magnetic state of the fluid amalgams is accelerated by tapping; with solid amalgams, however, this does not take place. The permanent magnetism, which the amalgams are capable of retaining, decreases with the increase of the mobility of the amalgam.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Hot Wire Mirror Galvanometer.—In an article by Mr. Friese in the "Elek. Zeit.," Nov. 14, he discusses analytically the relations in such instruments and gives an illustrated description of one which appears to have been a success. He desired to obtain an instrument which gives a sufficiently large deflection with such a small current that the resistance of the usual resistance boxes may be used in series with it; many difficulties were encountered. The instrument is quite simple in construction; the wire is contained in a long vertical glass tube and the bottom is attached to the frame through a spiral spring; the lower end of the wire is attached to a horizontal lever, the other end of which is connected to the bottom of the instrument through an Ayrton spiral spring (made of a flat band wound as a spiral spring in the form of a cylinder; it has the property of exerting a torque when elongated); the two springs are parallel to each other and are attached to the two opposite ends of the lever, their forces being made to almost balance each other; the Ayrton spring is attached to the mirror as also to a damper moving in the oil which fills the lower part of the instrument; if the Ayrton spring were connected directly to the hot wire the sensitiveness would not be as large as it would be possible to make it, as its sensitiveness depends largely on the tensional strain on it, which in this instrument is produced by the other spring and is only varied by the expansion of the hot wire; the latter is adjusted so as to produce about 1.5 to 2 times the deflection which it is desired to use in measurements without introducing a correction factor; there is then no danger in tearing the wire; it is almost aperiodic. He gives the results of tests showing that the instrument may be used as a standard; its resistance is nearly 100 ohms; with currents varying about 300 per cent. the constant does not change within the limits of observation errors; a second test showed that after several days the constant still remained the same.

Sullivan Marine Galvanometer.—A very favorable report by Mr. Rymer-Jones on the use of this marine galvanometer on board ship, is published in the English journals Nov. 15; he obtained very satisfactory results although it was subjected to a very severe trial; he found that it is very superior to the old iron-clad Thomson marine galvanometer; the coil is three times as sensitive and the instrument is remarkably steady.

Standard Cells.—In a report of the Reichsanstalt, abstracted in the "Elek. Zeit.," Nov. 14, very favorable results are expressed for the Weston cadmium standard cell. The temperature coefficient was about 0.001 per degree; a number of cells were constructed, and it was found that they could easily be reproduced with the same constant, and that in this respect it is not inferior to the Clark cell, while its temperature coefficient is so small that in most measurements it may be neglected entirely; it is about one 23d as great as that of the Clark cell; its E. M. F. at 20 degrees is 1.0225 legal volts, a figure which is to be determined more accurately with the absolute dynamometer; the cell has been used with good results in the Reichsanstalt; with 1.1 per cent. of cadmium the E. M. F. is very nearly one volt, as was found from a large number of cells made with different proportions; the results were very favorable, and it is believed that this "excellent cell" may be endorsed. With very great care, Clark cells may be constructed which do not differ in voltage more than one part in ten thousand.

Wheatstone Bridge.—An article by Dr. Kohlrausch from the "Wied. Ann.," Nov. 10, is noticed briefly in the Lond. "Elec.," Nov. 15. He describes several improvements. He uses a long wire wound on a roller in a flat groove, the roller being marble or paraffined wood. To increase the accuracy, resistances are connected at each end amounting to 4.5 times the resistance of the wire itself. When the inequality between the

two resistances to be compared does not exceed 20 per cent. and the scale can be read to 1 in 10,000, the error of the determination does not exceed 1 in 25,000.

The Reichsanstalt.—The "Elek. Zeit.," Nov. 14, reprints an abstract of a report of the work of this institute for the year ending April, 1895; some of the remarks regarding the standard cells are noticed above under separate heading. Under standard resistances it is stated, among other things, that the changes of a one-ohm resistance of manganine do not exceed a few hundred thousandths of their value during a period of two years. The Helmholtz absolute electrometer and measurements with it are briefly described; the accuracy was found to be 0.0001. Under the heading of magnetic researches, some experiments are described in which the magnetization of iron and steel wires were determined when it lasted only a few thousandths of a second, and when it lasted an appreciable time, and it was found in every case that there was no difference which could be attributed to the difference in time. For calibrating voltmeters a battery of 5000 cells of accumulators is being constructed, having a capacity of 1 ampere-hour and a discharge current of 0.1 amperes; there will also be transformers for 20,000 volts. Some magnetic researches made with ellipsoids and with rings showed that there was an unaccountable difference between the results obtained.

Electric and Mechanical Units.—A mathematical paper of some length, by Mr. Perrin, discussing the dimensions of these quantities, is begun in "L'Eclairage Elec.," Nov. 2.

Conductor Materials.—Dr. Perrine's article is continued in "Elec. Eng'ing" for November. He discusses conductors used for resistance coils for absorbing energy; the chief governing factor is to obtain the resistance and carrying capacity at the lowest cost, and therefore as high a temperature as possible should be used; it is important that there should be no permanent alteration in the resistance due to annealing or oxidation; both manganine and arsenical copper are therefore unsuitable for use in the open air; in enameled wire rheostats currents may safely be carried which under ordinary circumstances would completely fuse the wire. The location of the wires in relation to each other and surrounding bodies influences the result so greatly that many tables which have been published are of little value except as a general guide; he gives the results obtained by Mr. Dettmar (see Digest, Jan. 6, 1894), showing the spacing of spiral coils, which will give the most rapid cooling effect; he also gives the table of Mr. Herrick for the carrying capacity of various resistance wires; Mr. Morris is quoted as giving the following as the amount of energy which may safely be absorbed: A wire 20, 40, 54, 80 and 104 mils in diameter will absorb 1, 2, 3, 4 and 5 watts per meter, respectively; the results do not depend on the material of the wire as the energy varies inversely as the square root of a specific resistance, while the resistance of a meter varies directly as the square root of the specific resistance. He considers these tables as the best obtainable at present, but their application will depend so much on the conditions under which the wires are used that but little absolute reliance can be placed on the results. In considering safety fuse wires he gives the composition of a number of alloys fusing at various temperatures. To avoid the influence of terminal blocks he suggests that for currents not exceeding 10 amperes the wire should have a length of about 2 inches, and for greater currents 6 inches. He recommends covering the fused blocks in spite of the uncertainty introduced thereby in the melting point; whenever the molten metal is not a source of danger more adequate protection can be obtained from materials having a high melting point. In conclusion, he gives results obtained by Mr. Preece some years ago regarding the fusing of wires.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Proper Size of Telephone Central Stations.—Mr. Hultman, in the "Elek. Zeit.," Nov. 14, discussed at some length the subject of how large such central stations may be made. It is well known that the cost per subscriber increases appreciably with the number of subscribers, while the mean length of the line also increases, as a rule, with the number of subscribers; many authorities are under the impression that there is, therefore, a limit to the number of subscribers connected with one station, and that this limit should not exceed 6000 to 8000. He considers that this is based on wrong premises, and shows in the present article that the contrary is the case, that is, that the stations in dense districts should be made as large as possible, even up to 20,000 or 25,000 subscribers; he believes that it will not be impossible to make switchboards of such a large capacity, but this is not entered into in the present article. He finds the relation between the cost per subscriber for a large station and then for the case when there are a number of smaller stations connected together. He draws the following conclusions: It is in general not advisable to divide a city into small districts, each with a central station, and that this applies more to large cities than to small ones; that in general, telephone districts should not be made smaller than 3 to 3.6 miles square, and that for very large cities they should be larger rather than smaller, especially when most of the subscribers, as is generally the case, are confined to a small district; that in large cities the switchboards should be made of as large a capacity as it is possible to construct them, that is, up to 20,000 or 25,000 subscribers; and finally that the cost of the circuits be made as small as possible, using underground cables with a large number of wires.

Long-Distance Telephony.—In "L'Eclairage Elec.," Nov. 2, Mr. Hess criticises unfavorably the recent suggestions of Mr. Baradat, which were abstracted in the Digest, Nov. 9. He has little confidence in the success of the proposed method. He believes that the author forgets that the telephone, like all other apparatus, will take a current corresponding to its resistance and self-induction. With the high frequency of telephonic currents, the resistance may be considered negligable as compared with the self-induction. The excitation of a telephone is a question of its construction, and may be adapted to high or low voltages; it is not rational to expect to increase the power by adding one more transformation, the efficiency of which is less than fifty per cent. The problem of long-distance telephony is no longer that of the loss on the line, the quantity of energy being a secondary matter as compared with the form in which it is used, and this is especially the case for long distances in which the capacity and self-induction of the line act differently on the different components of the complex telephonic waves which they retard and weaken. This retardation and weakening affects different components of a wave unequally, and therefore the wave arrives deformed, while a mere loss of energy due to a Joule effect, produces no such deformation. Regarding the closed magnetic circuit induction-coils, he states that these have been tried by others, but the expected results were not obtained.

Holland.—A translation, in abstract, of the article mentioned in the Digest last week, is published in the Lond. "Elec.," Oct. 15.

Automatic Cut-out For Bell Batteries.—A system devised by Mr. Badt is described and illustrated in the "West. Elec.," Nov. 30; it is a device for automatically breaking a bell, gas-lighting or annunciator circuit after it has been closed for a certain length of time, thus preventing the battery from becoming exhausted in the case of accidental short-circuiting; it consists of a device, which is affected by changes in temperature, the heat developed by the current, after it has been flowing a certain time, completing a local circuit through an electromagnet, which breaks the circuit of the battery.

Laboratory Telephone.—In the "Elec. Rev.," Nov. 27, Mr. Caldwell gives an illustrated description, accompanied by working drawings, of a magneto-telephone for laboratory purposes, one of the special features of which is that the winding may be changed conveniently, keeping the same magnet and diaphragm, and exactly the same adjustment.

MISCELLANEOUS.

Cyanate of Calcium.—"L'Ind. Elec.," Nov. 10, publishes a correction of the article which was abstracted in the Digest, Nov. 23; where it read 100 kg it should have read 1000 kg, as was suggested in the abstract.

Electric Light and Power from Garbage Crematories.

Since the publication of Mr. Charles Jones's book on "Refuse Destructors," a great deal of thought, says Mr. Maurice Barnett, has been bestowed on the question of the incineration of refuse; not only on account of the great value possessed by this sanitary method of garbage disposal, but because of the economic possibilities that attend the utilization of the calorific value of garbage as fuel. From the 50 destructors mentioned by Mr. Jones, consuming daily from three and a half to ten tons of garbage, there is obtained on an average from five to seven horse-power per cell.

It would thus seem, with "destructors" in such successful operation abroad, with conditions as favorable here as elsewhere, with many municipalities owning their own electric light plants, and, lastly, with a strong popular feeling in favor of the sanitary combustion of refuse, as if there were strong reasons why this matter of crematories operated in conjunction with industrial lighting plants should be taken up here as it has been in England. It is surprising that there are in this country no such combined plants as abroad, the only explanation resting on the assumption that sanitary cremation companies were not fully alive to what was accomplished with different forms of storage apparatus.

Of the various forms of storage, as steam storage, feed storage, combined feed and steam storage and storage batteries, the last, both on theoretical and practical grounds, would seem to be the best "because of its forming the last link in the chain, thereby giving the economies of continuous working to all that precede." The basis for this statement is the fact that storage batteries are cheaper in first cost than the equivalent steam-power plant which they would replace, have a wider range of power and are more economical in operation than other forms of storage apparatus.

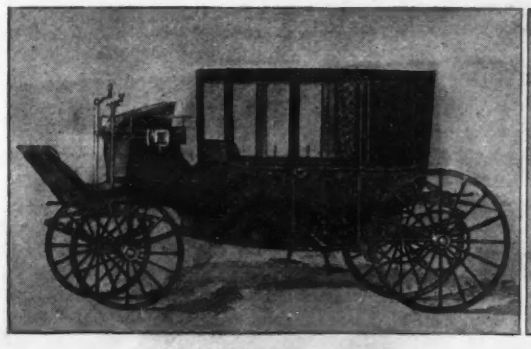
It is to be hoped that municipalities having or contemplating the establishment of their own lighting plants will seriously consider the question of combining their lighting station with some well-equipped garbage crematory supplied with efficient storage apparatus. Besides having a sanitary method of disposing of their refuse, they would find that their lighting plant could be operated cheaper than without the crematory adjunct, while the storage apparatus, besides enabling them to use the heat going to waste the greater part of the day and night, when there is not a large demand for power, would give a wide range of power to the lighting station, enabling it to respond to the fluctuations of load incidental to electric lighting and save the generating machinery from the strains to which it would otherwise be subject.

Electrical Vehicles.

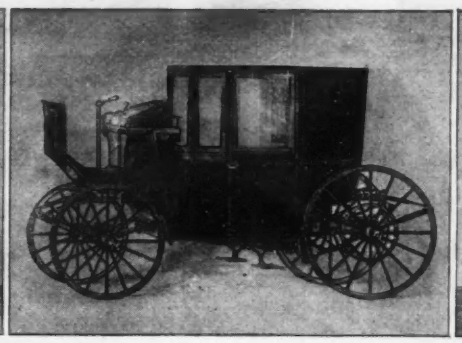
Before an equipment of any kind can be satisfactorily devised or designed as a commercial product it becomes absolutely necessary to make a study of the conditions to be met in operation as they now exist, and to provide an equipment which shall successfully meet these conditions, regardless of sentiment or visionary prospects. This has been done with reference to electric vehicles or motocycles from a practical and engineering point of view by the C. E. Woods Company, Monadnock Block, Chicago, with some interesting results.

It was found from the result of several hundred inquiries that the average run of a cab, or public brougham, sometimes called a coupe, does not exceed 25 miles a day; hacks do not exceed on the average over 20 miles a day; time rentals for liveries do not exceed an average of over four hours, which would not average over 25 miles a run, while light delivery wagons rarely exceed 40 miles in a day. From a practical and commercial point of view it would, therefore, hardly seem necessary to equip a vehicle for a continuous run of from 10 to 14 hours, or for a mileage capacity of favor of electricity, except with respect to not having as favorable access to fuel renewal as in the case of the others; the establishment, however, of electric liveries and supply stations in large cities will overcome all these objections, and this would follow adoption of electric road traction.

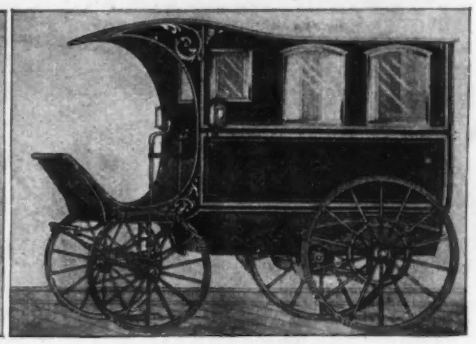
In design, the electrical vehicle will not present the mechanical appearance which the others must necessarily have, but in both instances the departure from shape and form in vehicles as we now know them will not be very radical, except, of course, for the same amount of work the vehicles must necessarily be constructed somewhat heavier. The electric brougham and the electric landau, as herewith illustrated, have but little difference in their general contour as compared with the ordinary horse vehicle, yet the brougham is fitted with 24 cells of storage battery, and two .9-kw motors, or equivalent to a little over 2½ hp. The batteries are of a sufficient capacity to give a continuous normal effort of 2½ hp for five hours. The landau is equipped with 32 cells of battery and two 1.2-kw motors, making a normal power of 3½ hp. The trap is fitted with 20 cells of a smaller battery, and one 1.5-kw motor, or about 2 hp. A top carriage is fitted with the same equipment as the brougham,



LANDAU.



BROUGHAM.



DELIVERY WAGON.

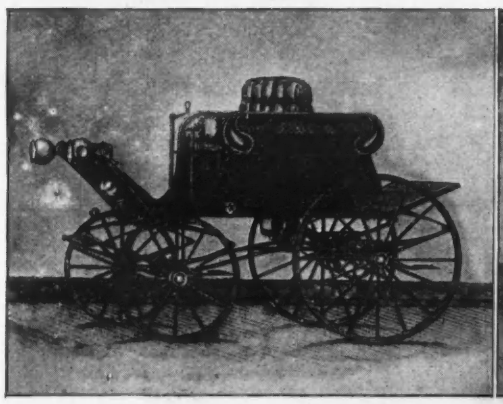
100 or more miles, as claimed by some, except such vehicles as are intended to run on long stretches across the country; ordinarily the equipment would be a useless amount of weight to lug around for no advantage except in a special emergency. Pleasure wagons are never used more than three or four hours at a time; cabs, hacks, etc., making a run of 20 to 25 miles a day do not run on the average of over five or six miles per hour.

As to the relative advantages of gasoline and petroleum equipments, the former are but 25 per cent. lighter than good storage batteries, and do not take up much less room in the vehicle; their unfavorable and undesirable qualities are the disagreeable odors which accompany them; the unpleasant noise they make in operation, both mechanically and by their exhausts; the amount of heat which they must necessarily contain and carry with the vehicle; the fallibility of igniters, and lastly, presence in the vehicle of combustibles, which, no matter how well surrounded by safety guards, invariably prejudice the public mind. On the other hand, the favorable conditions are: Somewhat lighter weight; a much greater mileage capacity with one charging; accessibility to fuel at most any

while the light delivery wagon has the same equipment as the landau, and the light buggy has a 1.2-kw motor.

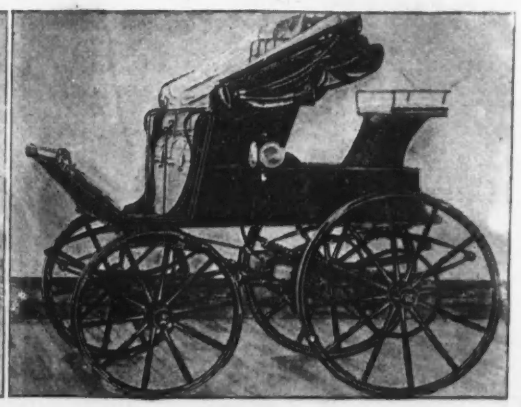
In the top carriage the controlling device and steering arrangements are so designed as to operate the vehicle either from the footman's seat or the main seat of the vehicle. In the trap and wagons but one motor is used, which is on the rear axle, on which axle is also a strap brake; the other and heavier vehicles using two motors have one motor on either hind wheel. The design in proportioning the carriage is such that three fifths of the load is to rest on the driving wheels, in order to secure proper traction.

The application of two motors is desirable in public and street vehicles for large cities, as they will form their own mutual adjustments in the difference of speed between the two wheels in turning corners and other gyrations through the streets. These larger vehicles have an adjustment to five different speeds without the use of any rheostat whatever, and are so arranged that it is impossible to put on the brake without cutting off the current from the motor; the act of putting on the brake doing this before the shoes form their grip on the wheel.



ROAD WAGON.

TRAP.



T CART.

point, and lesser cost in operation. The comparative difference is given as follows: Mileage capacity in petroleum and gas equipment, 100; mileage capacity in electric storage-battery equipment, 60; cost per hour for running gas and petroleum vehicles, about 25 per cent. less than for electric equipments. These figures apply to equipments of the same power in any type.

For an electrical equipment the weight is given as 800 pounds, as compared to 500 and 550 pounds for gas and petroleum equipment, but the former has the advantage of no noise, no heat, no presence of combustibles, far less mechanical complications, more instantaneous control and no reciprocating motion. The conclusion is drawn that, equipment for equipment and mileage for mileage, everything would seem to point in

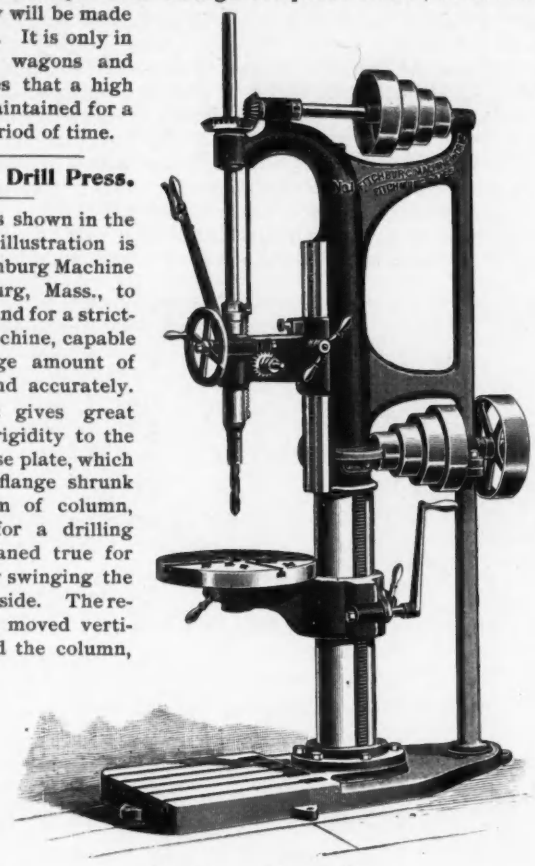
The makers state that the entire construction of the electrical equipment has been designed with the same engineering care and study that would be given to a high-class electric railway proposition. The motor is of a special design, with special windings and design which will permit double the normal power to be used, under certain combinations, for starting torque, and for climbing grades. Much study has been given to the design of controlling devices to protect the electrical equipment in ignorant hands, and also be positive in action and operation.

In the vehicles illustrated, the equipment has been designed to meet the specific conditions of each vehicle, with as artistic design as possible in the form of body. A vehicle equipped with a normal work of 2½ hp for five consecutive hours has in reality a much longer run than that

time. If on a level road, the horizontal effort given by that power would produce a speed of 12 or 14 miles per hour; a lesser speed of, say, five or six miles, would give nearly a *pro rata* difference in length of time for operation, but not in mileage capacity. It is doubtful if public conveyances and business delivery wagons will be allowed a much greater speed than five or six miles per hour through the public streets, while often much of the way will be made at less than this. It is only in the light road wagons and pleasure vehicles that a high speed can be maintained for a considerable period of time.

A Serviceable Drill Press.

The drill press shown in the accompanying illustration is built by the Fitchburg Machine Works, Fitchburg, Mass., to supply the demand for a strictly first-class machine, capable of doing a large amount of work quickly and accurately. The back post gives great strength and rigidity to the column. The base plate, which is bolted to a flange shrunk onto the bottom of column, may be used for a drilling table, being planed true for this purpose, by swinging the circular table aside. The revolving table is moved vertically and around the column, and the drill head is so arranged that it may be set at any desired height. The spindle is made of steel, with end bored to the Morse taper.



Fitchburg Drill Press.

The design is entirely new, and the object in view has been to so distribute the metal as to give the best possible result, both for strength and attractiveness. A durable friction clutch within the lower cone enables the operator to instantly start or stop the drill spindle. As there is no shipping of the belt only a 3-inch face pulley is necessary on the line shaft. Worm and worm-wheel feed, with quick return, is provided, together with a ratchet hand lever for hand drilling.

The head, table and arm are clamped by means of binders, therefore no wrenches are required for the drill. The dimensions are as follows: Diameter of revolving table, 18 inches; distance from centre of spindle to post, 9¼ inches; distance from revolving table to end of spindle, 37 inches; distance from drill or lower table to end of spindle, 49 inches; traverse of revolving table, 22 inches; traverse of spindle, 7 inches; diameter and face of driving pulleys on lower shaft, 12 inches x 3 inches; revolutions driving pulleys should make per minute, 400.

An Electric Amalgamator.

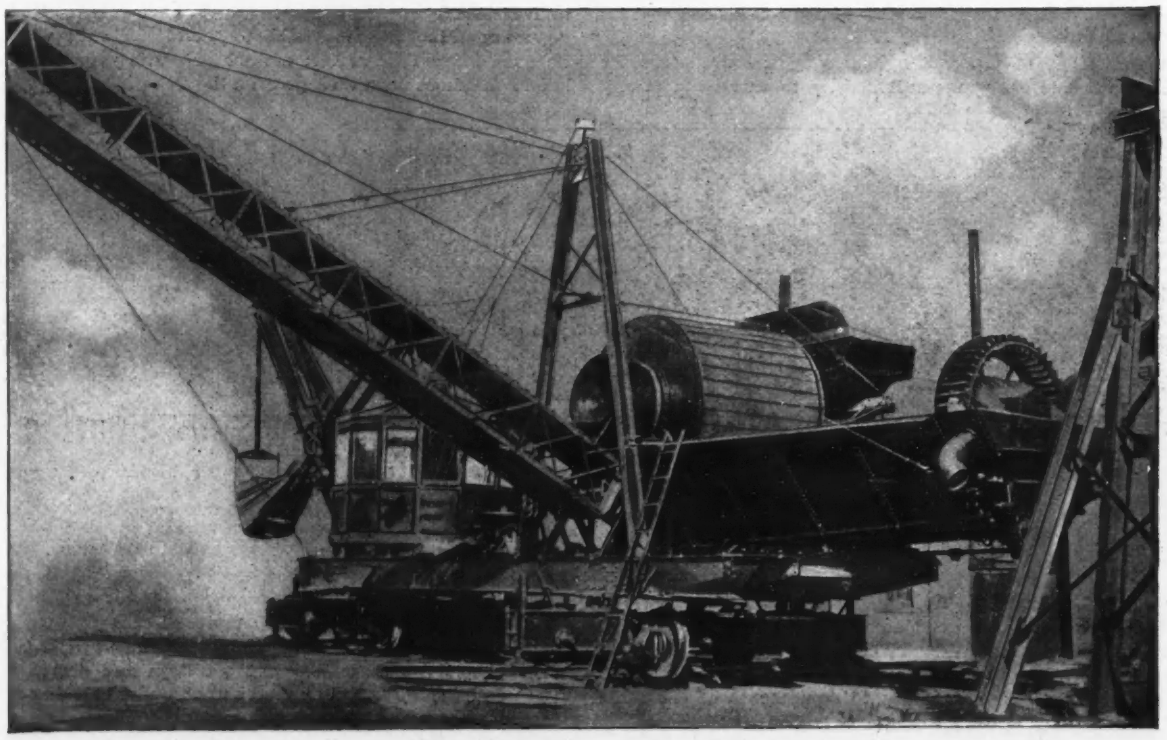
An interesting application of electricity in the mining industry has recently been made in the adaptation of electric motors to the operation of an amalgamator. The amalgamator consists essentially of the following parts: A truck and frame for supporting the larger part of the machine—arranged to be run forward on a track as the work progresses; a turn-table supporting a boom and dipper, the boom and dipper for excavating the dirt, and a revolving cylinder or screen with a hopper. Into this the earth is thrown from the revolving screen, the finer material passing through into the amalgamator, the coarse material being discharged at the end of the drum into the tailings carrier.

The amalgamator is a large trough, in which the fine material, after passing through the screen, is amalgamated. In the bottom of the amalgamator is an agitator, moving backwards and forwards to keep the material well stirred up, and a wheel for raising and discharging the fine tailings after the removal of the gold.

The four motors used in operating this machine have been supplied by the General Electric Company, and are constructed so as to be thoroughly protected from water or dust. One of these motors is mounted on the frame of the machine between the turn-table carrying the cab and the revolving screen. It is geared to a shaft connected by a sprocket chain to the revolving cylinder, the tailings carrier, the agitator in the amalgamator, and the wheel for discharging the tailings at the outer end of the amalgamator. A clutch is provided to throw it into gear with the trucks for moving the entire machine backwards and forwards.

The second motor is placed in the cab, and operates the dipper by means of a fine wire rope, passing around the drum to which the motor is geared. The third motor is mounted on the dipper boom, and is geared to a drum placed just above it. Fine wire ropes pass around this drum and are attached to both ends of the dipper handle. The dipper may thus be thrust out or in, according to the requirements of the work.

The fourth motor occupies a place in the cab, and drives by means of a beveled gear and large sprocket chain the turn-table. This motor is also used to swing the dipper boom around from the front of the amalgamator to a position which allows of the dirt being thrown into the hopper of the revolving screen. The motor operating the cylinder, the tailings carrier and the agitator in the amalgamator runs continuously when the machine is in operation, and is provided with a simple starting rheostat only. The other three motors are controlled by reverse rheostats in the cab, and are handled by one man.



Electric Amalgamator.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Nov. 30, 1895.

THE ELECTRICAL STOCK LIST is exceedingly dull, in harmony with the general stock market. Everybody seems to be persistently following Mr. Micawber's example, and the "something" as persistently fails to "turn up." The break in the business week caused by the Thanksgiving holiday has had a depressing effect upon the outside market in general, and trading has been limited. There has been somewhat more strength shown throughout the traction list, but the volume of business has not materially increased.

BUFFALO RAILWAY.—The declaration of the second quarterly dividend of 1 per cent. by the Buffalo Railway Company has caused a better demand for the stock at somewhat higher figures. Very little, however, appears to be for sale at present prices, and the recent pressure to sell has completely subsided. The dividend is payable on Dec. 10, and the transfer books close to-day. The company is said to be earning at the rate of 7 per cent. on its capital stock.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	96	97½
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	38	38¼
Electric Storage, pref	100	39	39⅜
General Electric	100	31	31¼
General Electric, pref	100	60	63
Westinghouse Consolidated, com	50	34¼	34¾
" " pref	50	54	54½

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	199	200
American District Telegraph	100	35	40
American Telegraph & Cable	100	92	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	61	61½
Gold & Stock Telegraph	100	105	..
New England Telephone	100	..	86
Postal Telegraph-Cable	100	82	83
Western Union Telegraph	100	87⅜	87⅝

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17¾	18
Binghamton RR. com	100	100	..
Brooklyn Traction	100	12	15
" " pref	100	59	61
Buffalo St. Ry	100	72½	74½
Cleveland City Ry	100	69	70
Cleveland Electric Ry	100	59	60
Columbus St. Ry	100	52	54
Consolidated Traction of N. J	..	25	..
Electric Traction, Philadelphia	50	..	..
Hestonville	100	..	..
Long Island Traction, all pd	100	15¾	16¼
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
New Orleans Traction	100	17½	21
" " pref	100	68	70
North Shore Traction	100	32	34
" " pref	100	83	85
People's Traction, $30 pd	25	..	..
Philadelphia Traction	50	71½	72
Rochester St. Ry	..	..	38
Steinway, Ry	..	46	..
Union Ry. (Huckleberry)	100	112	115
Union Traction, rcts $5 pd	..	13¾	14
West End, Boston	100	69	69½
" " pref	100	93	..
Worcester Traction	100	15	17
" " pref	100	84	86

BONDS.

Buffalo St. Ry. 1st con. 5s	100	102	105
*Binghamton Railway Co. 5s	100	99	100
Cleveland Elec. Ry. 1st mtge 5s	100	102	104
*Columbus St. Ry. 1st 5s	100	98	101
Rochester St. Ry. 1st 5s	100	102½	104
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.
† Ex-Div.

NEW ORLEANS TRACTION.—The report of the New Orleans Traction Company for the month of October shows that the gross earnings have increased $30,012. The net earnings for the month amounted to $56,139, a gain of $23,238, while the operating expenses have increased $6776. These continued increases have had some slight effect on the common stock, sales of which are reported around 19. The preferred continues dull and rather weak.

NORTH SHORE TRACTION.—The yearly report of the North Shore Traction Company, for the year ending on Sept. 30, has just been issued. During the year the floating debt of the company, amounting to about $2,750,000, was paid, besides the accrued dividends of 12 per cent. on the preferred stock, and the regular quarterly dividend of 3 per cent. due in October. The gross earnings of the Lynn & Boston road, which constitute the main part of the North Shore system, amounted to $1,376,977, an increase of $138,567, while the net earnings show a gain of $100,479. The company is now said to be free of all floating debt other than its regular current accounts.

THE BROOKLYN DEAL.—Various terms continue to be mentioned on the Street by which the Nassau Company will acquire control of the Brooklyn Traction Company, none of which can as yet be verified. The published report that the existing stock of the latter company, amounting to $6,000,000 common and $3,000,000 preferred, would be wiped out, and $4,500,000 new stock issued, seems to be regarded as the most likely plan. The common stockholders, it is said, will have the option of paying an assessment of 2 per cent. and exchanging four shares of the old stock for one share of the new, and the preferred stock share for share; or the common stockholders may pay $750 for 100 shares of new stock and receive in addition, Brooklyn, Bath & West End bonds dollar for dollar. The new stock issued in exchange for the old common will receive, it is said, a guaranteed dividend of 2 per cent. the first year and 4 per cent. thereafter, while the stock exchanged for the preferred will receive 3 per cent. guaranteed the first year and 4 per cent. thereafter. Brooklyn Traction common stock has sold in limited amounts around 12, while the preferred has been somewhat neglected.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Dec. 2, 1895.

J. JONES & SON, 67 Cortlandt Street, have lately added facilities for manufacturing full lines of knife switches, cut-outs, attachment plugs, and other electric lighting specialties.

CHARLES A. SCHIEREN & CO., 45 Ferry Street, report that they are now tanning their own leather, running their tannery at full capacity, and tanning with pure oak bark by the slow process exclusively. The demand for this firm's leather belting is keeping the whole force busy and increasing daily.

THE SOLAR ELECTRIC COMPANY, of 65 and 67 Duane Street, has applied to the Supreme Court for the voluntary dissolution of the company, and Judge Beekman has appointed Senator Jacob Rice, of Kingston, one of the directors, receiver, with a bond of $8000. The liabilities are small, and the many friends of the company hope it will be reorganized and resume business.

I. P. FRINK, 551 Pearl Street, of Frink Reflector fame, is hard at work keeping up with orders, which continue rushing in on him thick and fast. Among the many prominent churches and institutions that have adopted his system of reflectors might be mentioned the following recent installations: Sacred Heart Hall, Indianapolis, Ind.; St. Mark's Church, Hanover, Pa.; Presbyterian Church, Oneonta, N. Y.; Masonic Hall, Summit, N. J.; Friends' Church, Indianapolis, Ind.; German St. John's Lutheran Church, Tamaqua, Pa.; First Congregational Church, Everett, Wash., and the establishments of Julius Oehme and John Wells, 384 Fifth Avenue, New York.

PROTEST AGAINST TROLLEY EXTENSIONS.—An emphatic protest against granting a franchise for a new trolley line through Leonard and Calyer Streets, Brooklyn, was made last week at a meeting of property owners, held in Association Hall, Manhattan Avenue, near Meserole Avenue. Applications have been made by the Flynn syndicate to the Board of Aldermen for a franchise to operate a line through the streets named. The property owners signify their intention to prevent the syndicate from operating cars through those two streets, and will also use their influence in trying to defeat their plans of getting a line through to that section under the plea that there are sufficient lines now in operation to meet all their requirements, and another line, they declare, would still further endanger the lives of their children. Particular stress was laid upon the fact that the proposed new line would pass in close proximity to two public schools, and this alone was sufficient to condemn any such application. During the meeting, however, the fact was developed that about one-half of the gathering were lukewarm on denying company's application to enter the ward by any of the streets. Many were inclined to make no protest to the company obtaining a franchise if an application was made for one of the streets which was occupied mostly by factories. The meeting was presided over by Alderman Nicholas Droge, and it could be readily seen during the course of the meeting that the chairman favored giving a franchise if the company selected a street other than a residential one.

Pittsburg Notes.

THE SUBURBAN RAPID TRANSIT ELECTRIC RAILWAY COMPANY has complied with the request of its patrons, and will, after Dec. 1, charge but one fare to the end of its line. Hitherto it has been charging five cents to the first toll gate, and five cents from there to the end of the line.

THE STREET CAR TAX.—The local street railway companies will be notified this week to pay the city tax, and the City Comptroller will urge the companies to settle without delay. The tax is $60 per year on each car, and aggregates about $15,000. The whole amount was collected last year, and the Comptroller thinks there will be no trouble this year. However, there are some defects in the city ordinance providing for levying the tax on street railway companies, and they may take advantage of this. The Comptroller will prepare an amendment which will likely be presented at the next meeting of Councils.

THE FIRST SECTION OF THE GREENSBURG, JEANNETTE & PITTSBURG ELECTRIC RAILWAY from Greensburg to Jeannette was opened to the public on Nov. 23. The cars are 26 feet long, each fitted with two 50-hp motors and controllers of the latest Westinghouse type. The cars are fitted up with electric heaters, electric headlights, and ten 16-cp lamps serve to illuminate the vestibules and interior of the cars. The generator is of Westinghouse multipolar type, with a normal capacity of 287 to 300 kw. The engine is the Harrisburg Machine Company's "Ideal"; it is double compound, and has a normal capacity of 375 hp. The work is progressing rapidly on the line from Jeannette, through Penn Manor, where the power-house is located, to Irvin, and from the latter point through several small towns, the line will be run to Wilmerding, where it will probably connect with the Second Avenue line, forming direct connections from Greensburg to Pittsburg, a distance of about 37 miles.

Western Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Nov. 29, 1895.

MR. W. P. ROBERTS, president of the Lynchburg Telephone Company, Lynchburg, Va., has been in Chicago for the past week, closing a deal with the Western Telephone Construction Company.

THE ELECTRIC STORAGE BATTERY COMPANY has, owing to the increase of business in this territory, been obliged to arrange for better office facilities. Mr. Woodward will therefore remove his headquarters from the present location to handsome offices on the 15th floor of the Marquette Building, on Dec. 10.

THE JOHNSON ELECTRIC SERVICE COMPANY, Milwaukee, holds the world's record for having installed in Minneapolis the largest tower clock movement ever put in operation. The clock is so large that any ordinary old-style clock movement would be entirely out of place in attempting to move the enormous hands and to strike the many bells. The clock is placed in the joint court house and city hall. The dials are 220 feet from the ground, and have a clear face 23 feet 4 inches in diameter. These dials are larger by 10 inches than those of the famous clock of Westminster, and are double the area of any other dials in America. The dials are of heavy plate glass, the central plate of which is 12 feet across in the clear. The four dials weigh about 14 tons total. This clock strikes the hours on a 7000-pound bell with a hammer weighing 175 pounds. It strikes peals at each quarter on six bells. When desired, it plays tunes on a chime of 10 bells, including the 7000-pound bell.

Canadian Notes.

OTTAWA, November 29, 1895.

SHERBROOKE, QUE.—The Provincial Government has passed a bill to incorporate the Sherbrooke Street Railway Company.

CHATHAM, ONT.—The Chatham Gas & Electric Company proposes putting in new machines and engines and remodeling its plant in the Spring.

OTTAWA, ONT.—It is the intention of the Ottawa Electric Railway Company to erect in the Spring at Hintonburg, a large building for theatre purposes.

AYLMER, QUE.—R. H. and W. Conroy have made a proposition to light the town by electricity, and a by-law will shortly be submitted to the ratepayers on the question.

GODERICH, ONT.—A company of citizens contemplates the construction of an electric belt railway through the County of Huron, with the town of Goderich as the chief centre.

TORONTO, ONT.—The Toronto Electric Light Company is about to erect a new arc-lighting station to cost about $20,000. The building will be constructed of brick and iron. Under date of November 19th, supplementary letters-patent were issued to the company, giving power to increase their capital stock from $500,000 to $700,000.

Electric railway schemes are being formulated on a large scale. The Hamilton Radial Railway Company now gives notice that it will apply to Parliament for power to extend its Guelph branch to Lake Huron.

PARRY SOUND, ONT.—A charter has been granted by the Ontario government to the Parry Sound Electric Light Company, with a capital of $200,000. The charter members are W. H. Pratt, Toronto; W. B. Armstrong, S. Armstrong, John Galna, Wm. Beatty and T. S. Walton of Parry Sound.

BELLEVILLE, ONT.—The Ontario government has issued a charter to the Belleville Traction Company, with a capital of $100,000, with power to construct and operate electric street railways in the city of Belleville. The charter members are S. A. Lozier, T. C. Lozier and R. E. Lozier, of Belleville.

HAMILTON, ONT.—E. A. C. Pew, the railway promoter, had an interview with the Council regarding his proposition to bring electric power to Hamilton by a waterway from the Grand River, and stated that as soon as a franchise was granted work would be prosecuted. The Hamilton, Grimsby & Beamsville Electric Railway Company proposes to erect a station north of the Reservoir.

ST. CATHARINES, ONT.—The Lincoln Radial Electric Railway Co. is applying to the Ontario government for power to construct and operate electric railways from the City of St. Catharine to the villages of Jordan, Beamsville and Grimsby north; branch lines to Campden and Smithville, passing through the townships of Grantham, Louth, Clinton, North and South Grimsby; a line to the village of Port Dalhousie and to the villages of Homer and Virgil and the town of Niagara, branching to the village of St. Davids and the village of Queenston.

VANCOUVER, B. C.—A telegram from Vancouver says that one of the biggest deals yet negotiated in British Columbia has just been concluded through London brokers, an English syndicate purchasing at a large price the Vancouver Electric Tramway Company, Vancouver Electric Light Company, the New Westminster & Vancouver Interurban Electric Tramway & Light Company, running a distance of 12 miles; also the New Westminster City Electric Tram Company. Half a million dollars will be spent in utilizing the water power of the Seymour River to run the entire system. An English syndicate has also bought the Victoria, B. C., Electric Tramway.

MONTREAL, QUE.—A deal is on whereby the Standard Light & Power Company and the Citizens' Light & Power Company are to be consolidated into one corporation. These two corporations own valuable franchises for the use of electricity in all its forms in Ste. Henri and Ste. Cunegonde and for street lighting in Westmount and St. Louis de Mile End, as well as lighting the harbor of Montreal. It is the intention of the new company to utilize the power which the Lachine Rapids Hydraulic & Land Company will have at their disposal when their works are completed. In this way the Lachine Rapids Hydraulic Company are finding a ready purchaser for their electric power. The new company will hold a franchise enabling them to construct electric railways in any city or town in the Province of Quebec.

The Park Island Electric Railway has been requested to give street railway connection between Cote St. Paul and the Municipality of Montreal.

Notice is given that application will be made at the approaching session of Parliament for an act to incorporate the Montreal & St. Lambert Bridge & Electric Railway Co. with power to construct a highway bridge from Montreal across the St. Lawrence River to a point in the Municipality of St. Lambert: also with power to construct an electric railway from the bridge to Chambly and Laprarie Counties.

English Notes.

(From Our Own Correspondent.)

LONDON, Nov. 20, 1895.

ELECTRIC SEASHORE RAILWAY.—The opposition of the Brighton Town Council, about which I wrote you some time ago, to the erection of poles in the sea, for the purpose of supporting a trolley wire for a novel form of seashore electric railway, has, as I expected, been overcome. The poles will be erected on the condition that they come down at short notice, if need be.

PACIFIC CABLE.—The Pacific cable scheme has advanced one more step; a very decided one. The Agents General of Australasia, Canada and the Cape waited yesterday upon the Colonial Minister, Mr. J Chamberlain, with a view of enlisting him and the British Government on behalf of the projected British cable from Vancouver to New Zealand. The result is that Mr. Chamberlain has promised to call together a special commission, in which England as well as the colonies concerned shall be represented, to go into the matter thoroughly, and has generally given the idea his benevolent patronage.

THE BRITISH ELECTRIC TRACTION COMPANY.—Public subscription to the extent of £50,000 has been invited in connection with the capital of the British Electric Traction (Pioneer) Company, Ltd. The objects of this company are somewhat undefined, and one may presume that they are of the promoter order. The prospectus states that the company has been formed to take steps for the development of electric traction in the United Kingdom and elsewhere, on systems which have already proved successful in the United States and on the Continent of Europe. The company will also investigate and test new and improved systems, and in due course, a larger company will be formed with adequate capital.

CENTRAL LONDON RAILWAY.—The experimental borings close to the Bank of England, which were recently begun in connection with the proposed central junction station for the proposed electric railways, have now been completed. These borings were made with a view to ascertain the character of the sub-soil; the bank directors being somewhat alarmed lest the bank should be let down by the hollowing out of the entire sub-soil in the open space between it and the Mansion House. Made earth was found down to a depth of something over 13 feet, then came a layer of gravel, then one of clay, then ballast, and at a depth of about 30 feet that excellent material for boring operations, London blue clay. It is to be hoped that the bank directors are satisfied.

OLD TELEGRAPHERS.—On Thursday evening a most enthusiastic scene was witnessed at the Holborn restaurant, the occasion being a dinner given to Mr. W. T. Ansell, of the Eastern Telegraph Company, in celebration of the jubilee of his connection with the telegraph service. Mr. W. T. Ansell is indeed an old telegrapher, but there was one present even older, namely, Mr. J. W. Wilkins, who, after having received training under Cooke and Wheatstone, proceeded to erect some of the first telegraph lines in the world. Mr. Wilkins, however, severed his connection with telegraphy more than 40 years ago, Mr. Ansell, on the other hand, is still in harness, nd if outward and visible signs of energy are worth anything, likely to remain in active harness for many years to come.

WATER SOFTENING APPARATUS.—Messrs. Mather & Platt, of Salford, have recently been exhibiting an apparatus for the removal of temporary and permanent hardness in water which it is intended to use for boilers. The process is partly chemical and partly mechanical. The water is placed in a

capacious tank, where it is treated with quick lime and soda ash for the chemical precipitation of the carbonates and sulphates in solution in it. The precipitation is accelerated by blowing air into the water, so as quickly to mix up the precipitate fluids with the water. When this stage is completed the mud at the bottom of the tank is blown up into the water and flakes the precipitate, enabling the latter to settle much more quickly than would otherwise occur. The settlement requires only one hour, and then the clear liquid is drawn off for boiler feed. Occasionally the liquid is carbonated as it is drawn off, that is to say, carbon dioxide is blown into it, so as to convert any slight amount of the normal carbonate of lime into the more soluble bi-carbonate. The process is the invention of Messrs. Archbutt & Deeley.

COVENTRY ELECTRIC TRAMWAYS.—One of the most interesting impending events in electrical circles is the opening of the six miles of electric tramway between Coventry and Bedworth. The generating and line equipment and the rolling stock have been contracted for by the General Traction Company, of Westminster, and both Mr. Graff Baker and Mr. J. E. Winslow, who are well known, I believe, in the United States, have been engaged upon this scheme. Except where it has been modified to suit the requirements of the Board of Trade, the system is essentially the American Westinghouse trolley system, and in many respects differs from that recently opened at Bristol. The track, which is a single one, is blessed with an inordinately large number of turn-outs, there being no less than 27 of these, so that it has been decided to use double trolley throughout. The trolley wires are supported almost entirely by span wires, which are in some places fixed to steel poles, and in other places are fastened to the walls of the buildings along the road. The feeder is carried overhead along one line of poles, except in the narrow streets, where it is buried. The general character of the track is undulating. There are some very stiff grades, but the curves are fairly easy. In the power-house there are two 100-kw Westinghouse railway generators, belt driven by two 150-hp Browett & Lindley single-cylinder non-condensing engines. Each of these engines has two massive fly-wheels. The normal load of the engines is about 120 hp each, but the governor has been arranged so as to give steam to a very late cut-off when the load is excessively high. Steam is supplied from two automatically stoked Babcock & Wilcox boilers. The machinery hall is admirably arranged, and contains in addition to the railway generating plant, a small, steam-driven dynamo for the inverted arcs and glow lamps with which the power-house and car-sheds are lighted, and several machine tools for the repairs. At the present time there are eight motor cars and two trailers, each of the former being equipped with two 25-hp Westinghouse railway motors and ten 16-cp lamps. The series-parallel arrangement is used for starting. Following the provisions of the Board of Trade, the line is divided into one-half mile sections, any one of which can be isolated in the event of a breakdown, and switch-boxes are placed at intervals on the poles.

General News.

NEW INCORPORATIONS.

THE SHEBOYGAN LAMP COMPANY, Sheboygan, Wis., capital stock, $10,000, has been formed by J. Donahue, W. C. Johann, J. E. Collins, Sheboygan, Wis., for the purpose of manufacturing electric lamps.

THE CLAY CITY ELECTRIC LIGHT COMPANY, Clay City, Ind., has been formed by William Parsons, Charles S. Nickey and Benjamin M. Guirl for the purpose of furnishing electric light, heat and power. Capital stock, $5000.

THE HAYES, TRACY, FYFE COMPANY, Chicago, Ill., has been organized by James Hayes, Edward C. Tracy and Herbert H. Schryver, with a capital stock of $30,000 for the purpose of manufacturing and dealing in electrical and mechanical devices.

THE BEDFORD ELECTRIC LIGHT COMPANY, Bedford City, Va., has been incorporated with a capital stock of $25,000, for the purpose of manufacturing electric light and supplies. The promoters are T. D. Berry, J. A. Clarke and C. E. Harris, Bedford City, Va.

THE PACIFIC ELECTRIC COMPANY, Tacoma, Wash., has been incorporated for the purpose of manufacturing and selling electric lights and shades and other electrical apparatus, by W. S. Dean, A. T. Espersen and Charles Bedford. Capital stock, $2000.

THE SKEEN ELECTRIC SWITCH & SIGNAL COMPANY, St. Louis, Mo., has been formed for the purpose of manufacturing electric switches, etc The promoters are A. T. Cast, Charles F. Joy, C. H. Witthofft and Ferdinand Cast, St. Louis, Mo. Capital stock, $5000.

THE CHEMUNG GAS & ELECTRIC LIGHT COMPANY, Elmira, N. Y., capital stock, $200,000, has been formed by C. G. M. Thomas, A. J. S. Pinkham, P. C. Shaffer and Frank McKelvey, New York City, for the purpose of making and selling gas, electricity, etc.

THE JOHNSON-LUNDELL ELECTRIC COMPANY, New York City, N. Y., capital stock, $500,000, has been formed to deal in dynamos, motors and railway apparatus. Those interested are E. H. Benedict, E. H. Johnson, Robert Lundell and F. S. Hastings, New York City.

THE LEECHBURG ELECTRIC LIGHT & POWER COMPANY, Leechburg, Pa., has been incorporated by J. D. Orr, Leechburg; W. W. Staub, Pittsburg, and E. F. Austin, Pittsburg, Pa., for the purpose of supplying electric light, heat and power. Capital stock, $16,000.

THE TACOMA AUXILIARY FIRE ALARM COMPANY, Tacoma, Wash., has been formed by J. M. Bell, B. K. Worley, D. B. Worley and W. E. Theodore for the purpose of constructing an electric auxiliary fire alarm system in Pierce County, Wash. Capital stock, $30,000.

THE BEATRICE ELECTRIC COMPANY, Beatrice, Neb., capital stock, $100,000, has been formed by John H. Horback, Paul W. Horback, Victor C. Lantry, John E. Smith and Albert E. Maxwell for the purpose of operating street railways and light, heat and power plants.

THE ALLEGHENY & EVERGREEN STREET RAILWAY COMPANY, Allegheny, Pa., has been formed to build an electric street railway in Allegheny County, Pa. The promoters are H. C. Bolster, Wm. L. Hartmeyer and J. C. Eckerman, Allegheny, Pa. Capital stock, $30,000.

THE SALIDA ELECTRIC COMPANY, Denver, Col., capital stock, $50,000, has been incorporated with a capital stock of $50,000, for the purpose of furnishing electric light, heat and power for Salida. The promoters are George A Goddard, James E. Johnston and John Brennan, Denver, Col.

THE MARYSVILLE GAS & ELECTRIC LIGHT COMPANY, Marysville, Cal., has been incorporated for the purpose of dealing in light, heat and power. The promoters are D. E. Knight, A. C. Bingham, Mary A. Knight and Thomas Syversten, Marysville, Cal. Capital stock, $500,000.

THE ALBANY, HELDERBERG & SCHOHARIE ELECTRIC RAILWAY COMPANY, Albany, N. Y., has been organized to construct and operate an electric railway in Albany and Schoharie Counties, by J. W. Van Valkenburgh, J. H. Brooks, and B. M. Secor, Albany, N. Y. Capital stock, $300,000.

THE ECLIPSE ELECTRIC LAMP COMPANY, Buffalo, N. Y., capital stock, $100,000, has been formed to make and sell electric lamps, etc. Those interested are T. F. Crean, Brooklyn, N. Y., H. H. Fulton, Elmira, N. Y., William Marison, Montclair, N. J., and Andrew Marison, Montclair, N. J.

THE HOLLISTER WATER COMPANY, Hollister, Cal., has been formed to furnish water for domestic irrigation and power, also to generate electric light and heat. Those interested are T. S. Hawkins, N. P. Briggs, John T. Lowe, E. A. Prepin and A. S. Jones, Hollister, Cal. Capital stock, $100,000.

THE PACIFIC COAST TELEPHONE & ELECTRIC MOTOR COMPANY, Los Angeles, Cal., has been organized by L. N. Gibson, W. S. Harrison, John C. Maccabe, S. Weathercott and H. J. Lloyd, Los Angeles, Cal., for the purpose of constructing and disposing of telegraph and telephone lines, etc. Capital stock, $100,000.

THE ST. JOSEPH RAILWAY, LIGHT, HEAT & POWER COMPANY, St. Joseph, Mo., capital stock, $3,500,000, has been formed by W. T. Van Brunt, R. A. Brown and J. H. Van Brunt, St. Joseph, Mo., and W. M. Harriman, New York City, for the purpose of constructing railways and furnishing electric light, heat and power.

THE SIERRA DEVELOPMENT COMPANY, Sausalito, Cal., capital stock, $250,000, has been incorporated for general development purposes, including mining, building electric plants, etc. The promoters are M. F. Hudson, Oakland, Cal.; E. H. Bixford, T. B. Keret, H. C. Campbell, San Francisco, and O. C. Millet, Sausalito, Cal.

THE OREGON ELECTRICAL CONSTRUCTION COMPANY, Portland, Ore., capital stock, $20,000, has been formed for the purpose of constructing, maintaining and operating telegraph and telephone lines between Portland and Astoria, Ore. The promoters are C. F. Heusner, F. C. Miller, and J. S. Urquhart, Portland, Ore.

THE LORAIN & CLEVELAND RAILWAY COMPANY, Cleveland, O., capital stock, $500,000, has been formed to construct, operate and maintain an electric railway between Lorain and Cleveland; and to generate electricity for light, heat and power. The promoters are B. Mahler, E. W. Moore, E. C. Tillotson, S. H. Short and J. B. Hoge.

THE HIGHLAND RAILWAY COMPANY, New Albany, Ind., capital stock, $25,000, has been formed to own and operate a railway in New Albany, to be operated by steam, electricity or other motive power. Those interested in the project are Henry Terstegge, John M. Shrader, Jacob Zinsmeister, and Charles Schwartzel, New Albany, Ind.

THE ATLANTIC CITY LIGHT, HEAT & POWER COMPANY, Atlantic City, N. J., capital stock, $250,000, has been formed for the purpose of furnishing light, heat and power by means of oil, gas and electricity. Those interested are W. F. Findlay, New York City; James R. Merritt, Philadelphia, Pa., and John M. Kelley, Camden, N. J.

THE PACIFIC WATER COMPANY, Kings City, Cal., capital stock, $300,000, has been incorporated for the purpose of establishing electric lighting plants, constructing and operating street cars, and engaging in various other enterprises. Those interested are William E. Ward, Benjamin S. Coppock, E. Coppock, H. V. Morehouse and A. L. Burbank, San Jose, Cal.

THE COLUMBIAN CONSTRUCTION COMPANY, Clarksburg, West Va., has been formed for the purpose of constructing and operating ice, cold storage, electric light, gas and water plants. Those interested are H. T. Miller, J. H. Johnson, Washington, D. C.; Frederick Balcolm, Jacksonville, Fla., and Fred C. Suter, Philadelphia, Pa. Capital stock, minimum, $500; maximum, $5,000,000.

THE PHILADELPHIA ELECTRICAL EQUIPMENT COMPANY, Philadelphia, Pa., has been organized for the manufacture and sale of electrical machinery and devices necessary in the erection of electrical apparatus. The promoters are Mathew Rettew, 3921 Locust Street, James R. Rettew, Thirty-third and Chestnut Streets, and E. T. Watts, 2446 Colorado Street, Philadelphia, Pa. Capital stock, $50,000.

THE AMERICAN AUDIBLE BLOCK SIGNAL COMPANY, Buffalo, N. Y., has been incorporated in West Virginia, for the purpose of acquiring patents relating to systems of electric and other signals pertaining to railways, etc., and selling and leasing the same. The promoters are Cyrus J. Wheelock, C. W. Hammond, John T. McLaughlin, Frank S. McGraw, and John F. Cochrane, Buffalo, N. Y. Capital stock, minimum, $500; maximum, $5,000,000.

TELEGRAPH AND TELEPHONE.

GOUVERNEUR, N. Y.—The village is in need of a reliable fire alarm.

MORGANTOWN, N. C.—Morgantown is to have a telephone system.

STEELTON, PA.—Steelton is agitating the question of a fire-alarm system.

SALAMANCA, N. Y.—There is talk of establishing a local telephone system here.

EAST LIVERPOOL, O.—A movement is on foot to secure a new telephone for East Liverpool.

OCONTO, WIS.—The Oconto Telephone Company has organized with a capital stock of $7500.

MEDINA, N. Y.—The project of a new telephone exchange is being quietly put under way by prominent men.

LOS ANGELES, CAL.—Herman D. Laguna has filed with the Councils his acceptance of the telephone franchise.

WHARTON, TEX.—It is probable that telephone connections will shortly be established between Wharton and Eagle Lake.

NEW RICHMOND, WIS.—C. W. Richards has applied to the City Council for a franchise to establish a telephone system.

ALEXANDRIA, VA.—A charter has been granted to the Home Telephone Company of Alexandria. F. B. Hubbell, of Baltimore, is president.

ORLANDO, FLA.—James M. Lemon, an electrical and mechanical engineer of Minneapolis, Minn., is desirous of putting in a telephone system at this place.

WILMINGTON, DEL.—Wilmington's new telephone company has commenced soliciting subscribers for the new system. The company has a capital of $250,000.

BERKELEY SPRINGS, W. VA.—A telephone company is being organized at this place and it is proposed to connect with Hancock, Sir Johns Run and Gt. Cacapon.

STONINGTON, CONN.—An agent of the Nixon Telephone Company, of Providence, R. I., has been in Stonington with a view of establishing a local telephone system.

BUTLER, PA.—A telephone exchange is being installed here by the American Electric Telephone Company, of Kokomo, Ind. The exchange will have a capacity of 200 instruments.

PORTLAND, ORE.—The Oregon Electric Construction Company proposes to construct and maintain telephone and telegraph line between Portland and Astoria and branch lines thereto.

MONSON, CONN.—The selectmen have granted a franchise to the New England Telephone & Telegraph Company, to erect and maintain poles and wires on certain streets of the city.

SISTERSVILLE, W. VA.—At a meeting of the City Council recently a petition was presented by Messrs McGhie & Moore of East Liverpool, O., asking for the privilege of putting in a telephone and telegraph system to connect Sistersville, Wheeling and Marietta with the various oil fields.

LEWISTON, MONT.—Efforts are being made to establish a telephone exchange in Lewiston. The Bank of Fergus County, the Power Mercantile Company and Charles Lehman are behind the enterprise.

ITHACA, MICH.—A meeting of the Gratiot Telephone Company was recently held, and it was decided to authorize the board of directors to secure the requisite funds and extend the line to Alma and St. Louis.

HARTFORD, CONN.—The Hartford Street Railway Company is about to construct a telephone line on its suburban roads, to enable the conductors to communicate with the car despatchers in case of accident or delay.

MIDDLETOWN, N. Y.—G. Christian, president of the Sullivan County Telephone Company, has arranged to extended his company's line from Liberty to Livingston Manor and Rockland, where it will connect with the Beaverkill Company's line to Lewbeach.

Electric Light and Power.

PROPHETSTOWN, ILL —Prophetstown is to have electric lights.

CARROLLTON, ILL.—The City Council has decided to advertise for bids to put in an electric light plant.

PEORIA, ILL.—The Park Board has instructed the engineer to formulate a plan for the lighting of Glen Oak Park.

OWEGO, N. Y.—The Owego Gas Company will shortly put in an electric light plant at the gas works on Main Street.

TRENTON, N. J.—The City Council of Trenton is considering the project of establishing a municipal electric light plant.

CATHLAMAT, WASH.—There is talk of putting in an electric light plant at Cathlamat, power being obtained from Burning Creek.

RED CLOUD, NEB.—Red Cloud is at work on the project to rebuild the flouring mills recently burned and operate them with electricity.

PATCHOGUE, L. I., N. Y.—It is possible that the Patchogue Electric Light Company will extend its wires to Blue Point and Bellport. President Jesse C. Mills can give definite information.

FREDERICKSBURG, VA —The City Council has authorized the committee on lights to contract with the Rappahannock Electric Light & Power Company for lighting the streets for three years.

INDIANAPOLIS, IND.—The six-story building to be known as the Eastman, Schleicher & Lee Building, to be erected at 7 and 9 East Washington Street, will be lighted by electricity and heated by steam.

ABILENE, KAN.—A franchise for 21 years' electric lighting has been granted by the City Council to Norris Bros., of Kansas City. A complete new plant will be put in at once and the old one removed.

DECATUR, ILL.—John H. Culver, of Decatur, has been granted a franchise by the City Council for putting in an electric light plant to cost $10,000. The franchise is for 20 years and the contract with the city will be for 10 years.

DELTA, PA.—The plant of the Delta Electric Light Company has been destroyed by fire. Loss, $2000. Insurance, $1000. The rebuilding of the works has not as yet been determined. Should it be done, the site would probably be Castle Fin, six miles from Delta.

ROCHESTER, N. Y.—Proposals will be received at the office of J. Foste G arner, architect, Granite Building, until noon, Dec. 17, for gas and electric fixtures for the new Monroe County court house. Address Lyman M. Otis, chairman of the building committee.

ST. PAUL, MINN.—A special joint meeting of the Common Council will be held in December for the purpose of discussing the lighting of the city by electricity. It is proposed to decide upon specifications for lighting the city under contract and to advertise for bids.

PITTSBURG, PA.—E. M. Bigelow, Director of the Pittsburg Department of Public Works, has advertised for bids for lighting the city with electricity and gasoline. The present contract will expire Jan. 1. The new contract is to run for five years. The city lighting costs about $16,000 a month.

ALLEGHENY, PA.—The Allegheny Select Council at its last meeting passed a general ordinance requiring all new corporations entering the city to put their wires underground within the limits of North Avenue, Allegheny, Avenue Cedar Avenue and the Allegheny River. The Allegheny Power Company was granted rights to put down electric wires under this ordinance.

ATLANTIC HIGHLANDS, N. J.—For some time past the Borough Council has had under consideration the securing of an electric light plant and to erect a pumping station, and an estimate has been made which provides fa five-mile circuit of 62,000-cp arc lights and a two-mile circuit for incandescent lighting. This plant, completed in connection with the present pumping station, will cost approximately $10,000.

MEDINA, N. Y.—Village Clerk J. William Cooper has adverised for bids for lighting the streets of Medina from April, 1896, to April, 1901. At present the street lights are in operation only from dark until 1 a. m., and only on nights when the almanac says there is no moon. Bids are asked on this basis, also on lighting every night until the same hour. Bids are to be opened Dec. 7. At present 61 lights are in use, of 2000 cp each.

The Electric Railway.

BURLINGTON, VT.—An electric line to Hinesburgh has been proposed.

MEADVILLE, PA.—The Meadville Street Railway will probably be extended to Cambridge and Edinburgh.

CHARLESTOWN, N. H.—An electric railway is proposed between Springfield and Charlestown, to cost $100,000.

WATKINS, N. Y.—It is intended to extend the Watkins & Montour Falls Electric Railway through to Horseheads.

OSWEGO, N. Y.—The Oswego Street Railway Company has asked for permission to extend tracks on Erie to Halsey Street.

NASHVILLE, TENN.—The Nashville Street Railway Company has been granted permission to extend its line on West Line Street.

PROVIDENCE, R. I.—The City Council demands that the trolley system be extended to the end of tracks on Park Avenue and North Main Street.

POINT PLEASANT, N. J.—The South Jersey Street Railway Company is now in the hands of H. H. Wainwright, of Manasquan, N. J., as receiver.

RED BANK, N. J.—The new electric railway company has made application for a franchise for additional track construction on Shrewsbury Avenue.

PITTSBURG, PA.—A charter has been granted to the Pittsburg & Monongahela Traction Company, and the company will build an electric road two miles long.

NEWTOWN, PA.—The Newtown, Langhorne & Bristol Railway which began work at Langhorne this week is the first electric railway to lay tracks in Bucks County.

CHESTER, PA.—Henry McAllister, consulting engineer of the Gloucester City Railway Company, states that his company intends to build several miles of new road soon.

NIAGARA FALLS, N. Y.—A single-rail electric railway from Fort Erie to Port Albina *via* Crystal Beach is proposed, and efforts are being made to organize a company to build the same.

XENIA, O.—The Rapid Transit Company has contracted with the George H. Mellen Company, of New York, to build an electric road between Xenia and Springfield, a distance of 25 miles.

ALBANY, N. Y.—Applications for franchises were presented at the meeting of the Greenbush trustees by the Albany Railway Company and the Albany, Greenbush & Bath Railway Company.

CHICAGO, ILL.—The Suburban Electric Railway Company, the enterprise which is to build 20 odd miles of railway through La Grange, Riverside and other suburban towns, proposes to furnish an example in rapid construction.

BOSTON, MASS.—The Milford, Holliston & Framingham Electric Railway has secured land on the New York & New England Railway, bordering Charles River and will at once erect a fire-proof power-house, with equipment capable of furnishing 500 hp.

ORANGE, N. J.—At a meeting of the Orange Common Council an ordinance was passed granting the Suburban Traction Company the right to extend its lines from the present terminus along Scotland Street and Tremont Avenue to the West Orange line.

HAGERSTOWN, MD.—The street railway projectors will ask the City Council to amend the franchise granted them, so they will be released from building a railway to Williamsport. The projectors say they will build a road from Hagerstown to Funkstown, first.

SANTA BARBARA, CAL.—The Santa Barbara Consolidated Electric Company, which holds franchises for electric road to Carpenteria, has acquired property on which a power-house will be erected sufficient for the needs of the line and for local supply of light and power.

PEORIA, ILL.—The Central Railway Company has been reorganized. At the meeting of the directors it was decided to redeem $200,000 of the first and $100,000 of the second mortgage bonds, and to issue new bonds in the sum of $750,000. A large sum will be used in improving the system,

HARRISBURG, PA.—A charter has been granted to the Chester & State Line Railway Company to build a line 4½ miles long, from the intersection of Chester Creek and the Delaware River, to the intersection of the Delaware River with the Delaware State line. John Edwin Thomson of St. Louis, Mo., is president.

BRISTOL, PA.—It is thought that a through trolley road from Philadelphia to Trenton, with the Holmesburg, Tacony & Frankford Railway as a connecting link, is among the probabilities of the near future. The Bucks County Commissioners have granted permission for the proposed road to cross the bridge over Neshamy Creek at Croydon.

SUFFOLK, VA.—L. D. Smith and J. W. McCormick, of Norfolk, having secured an option on the Suffolk Street Railway, are about to make a sale of same to a party of Pennsylvania capitalists who expect to convert it into an electric line. It is intended to extend the road to Lake Kilby and the Suffolk Fair Grounds, thence to Springfield and ultimately to Portsmouth.

COLUMBIA, IND.—A franchise has been granted to the Fort Wayne, Columbia & City Electric Railway, and work on the road will be begun soon. President Everett has stated that the road will be completed within six months. The Huntington, Columbia City & Ligonier Electric Railway, which will be built by Indianapolis capital, has also been granted a franchise and its construction will be commenced soon.

HARRISBURG, PA.—Arrangements are being made by the recent purchasers of Penn's Cave, Centre County, to build an electric road to connect the Cave grounds with the Lewisburg & Tyrone Railway at Centre Hall; also for the illumination of the cave by electricity. B. W. Russell and others have petitioned the selectmen for the location of street railway tracks on Lynnfield and Washington Streets. The line for which a franchise is now asked is to be called the Peabody, Lynnfield & Wakefield Street Railway, and connect the places named.

MISCELLANEOUS.

WESTERN SOCIETY OF ENGINEERS.—A paper was read on "Application of Electric Power to Industrial Purposes" before the Western Society of Engineers, at Armour Institute, Chicago, by Mr. George P. Nichols, the evening of Nov. 21.

Trade and Industrial Notes.

VALLEE BROS., 617 Arch Street, Philadelphia, have accepted the agency for the Upton arc lamp, and have on exhibition several of these lamps of various ornamental designs.

THE CONNECTICUT & ELECTRIC COMPANY, Meriden, Conn., reports shipments of telephones last week to Alaska and Mexico, and states that business is in a very satisfactory condition and growing daily.

MR. GEORGE VALLEE, of Vallee Brothers, electrical supply dealers, Philadelphia, has been ill for the past week and confined to his bed. He is convalescing, however, and expected back in the office in a few days.

PHILLIPS & MAISCH, 2936 Market Street, Philadelphia, have accepted the agency for the Allerton Lubricant Company, of Chicago, and carry in stock a full line of all the various oils and greases manufactured by the Allerton Company.

WITH GREATLY INCREASED SHIPPING FACILITIES and storage space, the Electric Appliance Company, of Chicago, is able to carry an increased stock of "O. K." and Paranite wires and line material. It is the purpose of the company to ship all orders for these goods from Chicago stock immediately on receipt of orders, and the present facilities make this practicable without difficulty.

THE SCOTT-PEARSON ENGINEERING COMPANY, 621 Commercial Building, St. Louis, Mo., was erroneously referred to in our issue of Nov. 16 as the A. D. Scott Electric Company, which latter concern went out of existence upon the formation of the new company by Messrs. A. D. Scott and F. J. Pearson. The Scott-Pearson Company has already begun to see those indications of a prosperous future for which so many young firms of less ability have to strive so patiently and long.

KEEPING UP TO DATE THROUGHOUT.—The *Columbus Lantern*, of Nov. 6, says the disposition of manufacturers of electrical apparatus to be well represented at the Ohio State University is typified in the recent action of the Standard Electric Company of Chicago. A year ago last May a 20-light arc dynamo was made especially for the university from the latest designs. Since that time the Standard Company has improved the regulating apparatus used on the machine, and sent without expense to the university the entire set of new parts necessary to adapt this new method of regulating to the old machine.

THE OHIO STORAGE BATTERY COMPANY, 52 Wade Building, Cleveland, O., is making specialties of battery plants for private houses, and small cells for surgical use, phonograph service, etc. This company manufactures the well-known Ford-Washburn accumulators, and has made an enviable record for its product. Flattering testimonials are on file from various users of these accumulators, and the company's policy of sparing no pains to produce the best of goods is now reaping its reward in the shape of substantial recognition from users of accumulators. The peculiar construction of the Ford-Washburn cell, the makers claim, renders it capable of standing enormous discharge rates without any deteriorating effects, which fits it particularly for traction purposes. It is said that one of the last acts of the late Franklin L. Pope was the preparation of an expert opinion stating that the Ford-Washburn cell does not infringe any other accumulator patent.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 26, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

550,242. ELECTRIC CAR LIGHTING APPARATUS; William Biddle, Brooklyn, N. Y. App. filed March 7, 1895. The combination with the dynamo and the secondary battery in an electric car lighting apparatus, of a regulator having electrodes in a conducting liquid, and a connection from the regulator to the electrolytic cell for varying the current from the main line in proportion to the saturation of the secondary battery.

550,252. COMMUTATOR BRUSH; N. M. Cross, North East, Pa. App. filed Oct. 29, 1894. A commutator brush, composed of a central core of sheet metal, having stiffness and resiliency, and an outer coating or mass around said bar, formed by winding metallic gauze thereon.

550,255. APPARATUS FOR HANGING AND CLEANING TELEGRAPH OR TELEPHONE WIRES; Alphons Custodie, Düsseldorf, Germany. App. filed May 15, 1895. The combination of a pair of supports with line wires carried thereby, a pair of pulleys, an endless wire passing around the pulleys, and scrapers secured to the endless wire and adapted to engage the line wires.

550,260. TELEPHONE CIRCUIT SIGNAL; M. A. Edson, Chicago, Ill. App. filed May 20, 1895. An electromagnetic relay, comprising an electromagnet with a central core, an iron casing, an interposed exciting helix, and a tilting disc armature resting on its edge in front of said core.

550,319. ELECTRIC TRAMWAY WITH UNDERGROUND DISTRIBUTION OF CURRENT; Alfredo Diatto, Turin, Italy. App. filed Sept. 18, 1894. In an electric railway with underground distribution of current, a circuit closing device comprising a cylinder containing a quantity of mercury, a rod or piston operating within the mercury in the cylinder, and a coupling piece serving to unite the wires of the conducting cable as a feeder for the current.

550,329. ELECTRIC PUMPING APPARATUS; Gustaf Rennerfelt, Arvika, Sweden. App. filed July 16, 1894. In an electrical pumping apparatus, the combination with a revolving armature, of a hollow pole-piece having a water way and cylinder therein, a piston working on the cylinder, and a driving connection between the armature and piston.

550,330. ELECTRIC PUMPING APPARATUS; Thurs Gustar Rennerfelt, New York. App. filed July 3, 1895. The combination with an electric motor, of a series of pumping cylinders, located in and forming a part of the field magnet, a piston working in each cylinder, and connected mechanism driven by the motor and common to all the pistons for actuating each piston.

550,344. ELECTRO-LOCOMOTIVE; Jean Jacques Heilmann, Paris, France. App. filed Feb. 13, 1895. In an electric locomotive, the combination with one of the driving wheels, of pairs of oppositely arranged pins, each pin passing through a spoke, a spring connected with pin and acting to force it towards its mate, a hollow armature shaft inclosing the axle, and of an internal diameter sufficient to permit relative displacement of the axle and shaft, and arms secured to the shaft, each arm entering between two opposing pins.

550,354. SELF-EXCITING CONSTANT CURRENT ALTERNATOR; Albert Schmid, Allegheny, and Benj. G. Lamme, Pittsburg, Pa. App. filed Aug. 24, 1891. The combination with the field exciting coils of an electric generator, of compensating or opposing coils on the armature connected in series therewith and developing counter potential.

550,355. SYSTEM OF ELECTRICAL DISTRIBUTION; O. B. Shallenberger, Rochester, Pa. Application filed Oct. 12, 1886. The combination of a three-wire system of electrical distribution, two converters, each consisting of a stationary body of inductive material and stationary primary and secondary conductors applied thereto, such converters having their secondary coils connected in series with each other and with the positive and negative conductors, a connection from the neutral conductor with the terminals of the secondary coils, and means for transmitting alternate or intermittent electric currents through the primary coils.

550,360. NON-WELDING CONTACT; A. J. Wurts, Pittsburg, Pa. App. filed April 11, 1895. An electrical contact device comprising a base or support provided with a recess, and an amalgam plug seated in the recess and projecting therefrom.

550,365. ELECTRIC ARC LAMP; Frank Emery, New York. App. filed April 22, 1895. In an electric lamp the combination with the carbon rod and brake wheel connected to turn in harmony with the movement thereof; a brake band applied to the wheel, and levers connected with the opposite ends of the band, of a magnet and connection therefrom for operating both the levers.

550,407. COMMUTATOR; John Dice, Wilkinsburg, Pa. App. filed Aug. 21, 1895. In a motor or dynamo, the combination with the armature, of a commutator having outwardly projecting flanges and grooves formed in its periphery, and a band encircling the commutator between the flanges and adapted to retain the armature wires within the grooves.

550,411. ELECTRIC SWITCH; Thomas Harper, New Brunswick, N. J. App. filed Aug. 29, 1894. A switch comprising a socket of insulating material having on its inner surface two insulated contact pieces adapted to form circuit terminals and a carrier of insulating material movably mounted in said socket with its surface in contact with the inner surface of the socket the carrier being provided with a contact piece arranged to contact with the respective contact pieces in the socket, the terminals being flush with the surfaces of the insulating material, whereby, at the instant of breaking contact the insulating material adjacent to each terminal is interposed between the terminals to break any arc which may form.

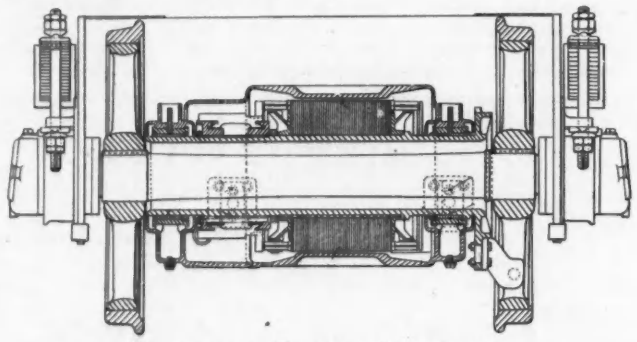
550,432. ELECTRIC LIGHTING GAS BURNER; J. M. Anck, Philadelphia, Pa. App. filed March 29, 1895. In an electric lighting gas burner, a cock or key provided with a stem, a support below the same, a spring mounted on the support and having its ends crossed and engaging the stem.

550,437. ELECTRIC RAILWAY; David Brooks, Jr., Philadelphia, Pa. App. filed Feb. 28, 1894. In an electric railway, a brush depending from the current receiving arm of a car, and a trough connected with an electric conductor, the brush spreading from the arm and freely resting on the trough.

550,458. TROLLEY; E. L. Richter, Philadelphia, Pa. App. filed March 27, 1895. A trolley pole, a sleeve attached thereto, a collar mounted on the sleeve, journals on the collar, an auxiliary pole or frame mounted on the journal, a second collar secured to the sleeve, and a spring intermediate the auxiliary pole and the last mentioned collar.

550,462. REGISTER FOR FIRE ALARM SYSTEM; N. H. Suren, New York. App. filed Jan. 29, 1895. In a telegraph register, the combination with the tape feeding train and the register magnet of a line marker having a movable platen, a cam moving the platen, a mutilated pinion moving the cam when brought into connection with a wheel on the feed train, and a pawl and ratchet operated by the magnet armature for throwing the mutilated pinion into engagement with the wheel.

550,464. DYNAMO ELECTRIC MACHINE; Elihu Thomson and Merle J. Wightman, Lynn, Mass. App. filed Dec. 2, 1889. In a dynamo electric machine, a coil carrier consisting of laminated ring structure for the generation of currents by revolving in front of like poles, such ring structure being mounted around a magnetic core, and a series of slots in the core directly under the laminated structure.



No. 550,344.—ELECTRIC LOCOMOTIVE.

550,465. ELECTRIC RAILWAY; George Westinghouse, Jr., Pittsburg, Pa. App. filed June 13, 1890. The combination of an electric railway car, a normally pivoted arm mounted thereon and swinging laterally, and an electric collector extensibly connected with the arm, so as to be capable of making contact with overhead conductors of varying altitudes and of being dropped below the conductor for the purpose of transferring it from side to side.

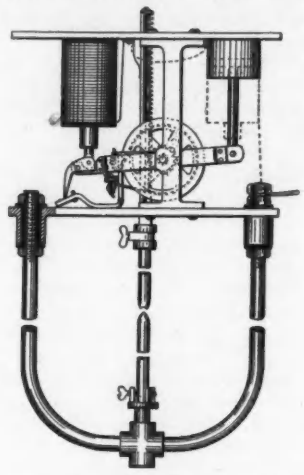
550,468. VENTILATING MEANS FOR ELECTRICAL APPARATUS; George Westinghouse, Jr., Pittsburg, Pa. App. filed May 2, 1895. A core plate for electrical apparatus having spacing projections stamped from the body thereof, and projecting substantially at right angles to its face.

550,469. APPARATUS FOR LIGHTING MINERS' SAFETY LAMPS; William Ackroyd, Birkenshaw, and William Best, Morley, England. App. filed Jan. 11, 1895. In a miners' safety lamp, the combination of the wick and wick tube, the electric lighting means consisting of two carbons, one attached to the wick tube and the other attached to a conductor spring, both carbons being at or below the level of the wick tube, the conductor spring being actuated by the conducting rod which passes through the lamp by way of the insulated tube, the electric current being supplied from a generator or accumulator.

550,480. PLATE FOR SECONDARY VOLTAIC BATTERIES; W. A. B. Buckland, London, England. App. filed July 15, 1895. A plate for a secondary voltaic battery, consisting of a conducting frame having a number of parallel bars provided at intervals with flattened portions, and strips of elastic non-conducting material strung on the bars and held separated thereupon by the flattened portions of the bars, and a filling of active material covering the flattened bars and the strips strung thereupon.

550,481. CONTROLLING APPARATUS FOR ELECTROMOTORS; J. B. G. A. Canet and A. Hillairet, Paris, France. App. filed Aug. 28, 1894. Apparatus for starting, stopping and controlling electromotors for operating bodies or machines of the kind hereinbefore specified, comprising a stop-switch, a reversing switch, and electromagnetic clutch, a shaft for operating the switches, a rheostat provided with a commutator, which is furnished with brushes, and one of the contact pieces of which forms a neutral contact piece, electric stops for breaking the circuit of the clutch, means adapted to transfer automatically the brushes to the neutral contact piece when the circuit is broken by means of either of the stops, and connections between the shaft and the brushes adapted to transfer the brushes both to and from the neutral contact piece.

550,484. ELECTRIC REGULATOR; George W. Colles, Jr., Hoboken, N. J. App. filed Feb. 4, 1895. The combination with the valve of a steam engine of an electric motor geared thereto, through a longitudinally reciprocating rod, an electric circuit controller for governing the currents of the electric motor, a lever pivoted to the rod, and having one arm controlling the circuit controller and having the other arm controlled by a given device.



No. 550,365.—ELECTRIC ARC LAMP.

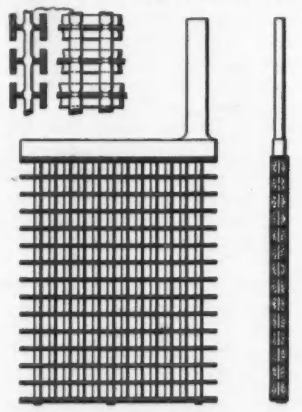
550,510. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed May 25, 1895. A system of telegraphic communications, consisting of sending and receiving stations, the sending station being connected with a source of rapidly recurring or alternating currents of electricity, the receiving station being connected with a vacuum or Geissler tube.

550,511. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Sept. 7, 1895. In a system of electric communications two or more stations connected together by line wire or cable, each being provided with the usual sending and receiving instruments and also with a source of rapidly recurring or alternating impulses for sending and a vacuum tube or similar instrument for receiving.

550,533. WELL FOR BATTERIES; Jens G. Schreuder, Edgewood, Pa. App. filed Dec. 2, 1893. A well for batteries provided with a lining formed of material refractory as regards atmospheric action, having a bottom formed integral therewith and provided near its upper end with a lateral opening having a protecting shield.

550,534. BATTERY WELL; Jens G. Schreuder, Edgewood, Pa., and S. H. Stupakoff, Pittsburg. App. filed Oct. 25, 1894. The combination of a battery well and a water reservoir, located at or near the lower end of the well, and having a portion of its walls porous and the bottom and the portion of the wall adjacent thereto non-porous.

550,535. RAILWAY SIGNAL; Jens G. Schreuder, Edgewood, Pa. App. filed April 20, 1895. In a railway signal, the combination of a casing having day signal and night signal apertures in its front and back walls, the day signal aperture in its back wall being smaller than that in its front wall, a day signal disc having a translucent central portion and a translucent night signal disc, and electric motor for simultaneously shifting both discs into and out of register with their respective apertures, the inner surface of the back wall around the day signal aperture being colored to give an indication the reverse of that given by the day signal disc, and a lantern arranged in line with the night signal apertures.



No. 550,480.—STORAGE BATTERY PLATE.

550,566. TRACK INSTRUMENT FOR ELECTRICALLY CONTROLLED RAILWAY SIGNALS; C. H Sherwood, Utica, N. Y. App. filed Dec. 10, 1894. In combination with a track instrument remote from the road crossing and actuated by the passing train, a piston actuated in one direction by the instrument, a spring restoring the piston to its normal position, an electric circuit maker and breaker, normally breaking the circuit and actuated by the piston to close the circuit, a detent movable to engage and release the piston, electromagnets actuating the detent to retain the piston in its circuit-closing position, a track instrument at or near the road crossing, a circuit maker and breaker actuated by the track instrument and normally in circuit closing position, and a signal actuated by an electromagnet in circuit with the circuit makers and breakers.